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Stoping Methods at Fairbanks

By Hubert I. Ellis*

SYNOPSIS—Efficient extraction of gravel from the Fairbanks mines depends upon the thawing of the ground and upon the proper handling of material. Shoveling is the crucial feature, and in it the best men and tools are employed. The frozen ground holds well, since it resembles concrete in strength.

In the typical drift mine, stoping commences at the crosscuts, about 200 ft. from the shaft, and is carried on toward the shaft. For the first thaw, short points 4 or 5 ft. long are used and these are driven in both sides of the crosscuts—one set pointing upstream and the other downstream—thus virtually making two thaws at one operation, as shown in Fig. 1. This is possible only with the first thaw, since it is impossible to shovel into one car from two faces that are constantly becoming farther apart and since the accumulation of waste and the slabbing of the roof prohibit the use of two cars under ordinary circumstances.

By running the crosscuts at a distance of 100 ft. from the shaft instead of 200 ft., by leaving frozen pillars along the runway in the stoped-out area and by working both toward the shaft and away from it, it would be possible to save part of the time and expense of opening up and at the same time to double the area of working face. So far as known, however, this scheme has never been tried in spite of certain obvious advantages. There is no evident reason why it should not be applied with success to small mines where only a small crew can be worked on account of lack of room at the face, but it is generally considered the best practice to commence stoping at the farthest point from the shaft and to work inward at all times, thus keeping away from the waste and the dangerous portion of the roof. The proposed combination method of stoping for small mines, whereby the number of shovelers can be doubled, is shown in Fig. 8.

MINING UNDER UNFAVORABLE CONDITIONS

Workmen are crowded, the car is small and on a poor track, and pools of water stand on the floor

Fairbanks placer miners are wont to consider all workmen "dead-heads" except the shovelers and it is therefore planned to have as large a proportion of them on the crew as possible. Consequently it is always desired to work as many men at a given face as can be done without interference, other things being equal, and the method of mining is devised with this end in view. Cars at the face are at a disadvantage in this respect, since four men are all that can conveniently shovel into one car at the same

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time. Where the gravel is tight, however, and picking takes up a considerable portion of the shoveler's time, it is sometimes possible to use six or even eight men to the car. With the ordinary mine with an upstream and a downstream face—each divided into two parts by the main drift—only two cars can be used at a time, since switches and turnouts are rarely included in the equipment. With wheelbarrows more men can be worked in a small space and they thus have an important advantage over cars for small mines. When using an eight-wheelbarrow bucket eight shovelers can work in each crosscut without interference, and by having one gang shoveling while the others are dumping their loads at the shaft this number can easily be doubled. For wide paystreaks, where there is ample face area, however, cars are to be preferred.

Type of Mine Cars in Use

To avoid raising the gravel farther than is absolutely necessary, cars must be as low as possible, and for this reason the ordinary mine car is unsatisfactory. Cars are usually built to hold four or five wheelbarrow loads of gravel and are made of light lumber lined on the inside with light sheet iron. The bodies are set directly on the trucks and are fastened firmly to them, so that in dumping it is necessary to raise the whole car, the front wheels serving as a pivot. Considerable skill is required to dump these cars without loss of time, since the forward part of the load frequently slides out, shifting the center of gravity well behind the front wheels and causing the rear wheels to settle back on the rails, from which position it takes a heavy lift to raise them. With experience the car man learns just the right speed required for the car to dump itself, but constant care is necessary lest the car over-ride the dumping obstruction and pile into the bucket-hole, load and all, in which event the shovelers must be summoned from the face, with consequent ill-feeling and loss of time.

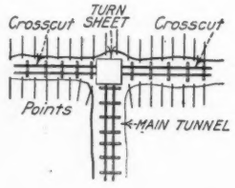

FIG. 1. METHOD OF PUTTING IN FIRST THAW

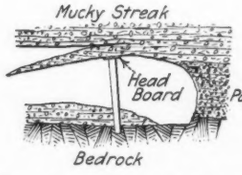

FIG. 2. STILL SET TO THROW SLAB AWAY FROM ROOF

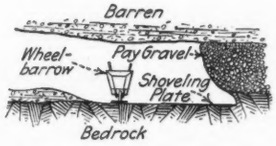

FIG. 3. METHOD OF UNDERCUTTING THE FACE

Effect of Thawing on Exposed Faces

For all thaws after the first, longer points are used and these are driven in the face toward the shaft. To shift the car track near the face the workmen scatter along it, drive their picks into the ties, and drag the entire section over at one time. When wheelbarrows are used at the face and dumped into cars in the main drift, the leader usually dumps his load and continues straight ahead into the other crosscut, thus becoming the last man on the next trip. This saves delay and serves to equalize the distance so that each man has the same average length of wheel.

In putting in a thaw it is impossible to avoid thawing some of the barren roof exposed by the removal of previous thaws, and this thawed portion either falls at once or hangs so precariously as to be dangerous to work under. In either case the part close to the face must be removed and it is thrown back where it is out of the way and where it serves in a measure to support the roof. The amount of waste thawed varies with the nature of the material and the care with which the points have been tended, but there is frequently a depth of two feet or more to be shoveled back before it is possible to attack the face. One advantage in the use of long points is that there is a proportionately smaller quantity of waste to handle.

After the pay has been stoped over a large horizontal area the roof, being left without adequate support, commences to slab. The gravel, especially that above the pay, always contains layers—of greater or less size and thickness—of muck or gravel consisting of a large proportion of muck and it is along these lines of weakness that the slabs form, as shown in Fig. 2. The slabs form very slowly. Starting as a mere crack, the opening gradually enlarges, the slab increasing in area and becoming thicker and thicker. Usually little change can be noticed from day to day, but they are a menace at all times to those working under them. If the face remains stationary for some time they break off close up against it and in the course of a week or two it becomes inaccessible. It is then necessary to drive a new crosscut to obtain a stoping base. Even when work is carried on continuously, if the face is not advanced very rapidly, the slabs may catch up while thawing is in progress and come down while the shovelers are at work. Fatalities from this cause are rare, however, since the slabs give warning a few minutes before they fall by a steady shower of small rocks sounding like a gentle rain. When the foreman receives this warning he moves the crew to another face, bringing them back after the slab falls, usually within half an hour or so.

Slabs continue to fall at intervals, the roof becoming higher and higher, until the whole space becomes filled and the roof is firmly held. In some cases subsidence extends to the surface, but this is usually not noticeable for several years after stoping, if at all. In a few years the entire mass usually settles so firmly that mining may be carried on underground exactly as before in case pay has inadvertently been left in the roof or in bedrock. Indeed, it would sometimes be difficult to tell that the area had ever been mined were it not for broken timbers and other such foreign material.

Holding Roof with Frozen Pillars

Many attempts have been made to hold the roof over stoped-out areas by artificial support, but without material success. Posts, plain timber bulkheads, bulkheads filled with gravel, drift sets, and other methods have consistently failed of their purpose, except where temporary support only was desired. The only sure way to hold the roof is to leave pillars of frozen gravel. These need not be large, 3 ft. in diameter at the small point usually being sufficient, and they need not be closely spaced. A few such pillars will hold as much as all the bulkheads that could be crowded into the mine. Observation indicates that pillars of concrete have no advantage over the frozen gravel

of the North when it comes to supporting weight. The most modern practice, however, is to make no attempt to support the workings except around the shaft and where it is desired to keep certain drifts open for communication with other workings. A row of stulls is sometimes placed parallel with the face a few feet back and these are canted backward at the top, as shown in Fig. 2, so as to throw any slabs that may chance to fall away from the face. Most of the stulls are recovered and used again and again.

The most expensive detail of placer mining is the picking of the gravel and the shoveling into wheelbarrows or cars. Refinements of methods are impossible and chief dependence is on the strength and endurance of the workmen. Men of an ingenious turn of mind have tried here as in other parts of the world to invent a satisfactory shoveling machine, but without success. One such machine worked to the entire satisfaction of the inventors in a snowbank at surface but balked when taken underground. The best the operator can do is to keep plenty of gravel before the shovelers, to furnish them with the best of tools in the best of condition and to eliminate delays by keeping runways, hoist and car tracks in good shape. The men

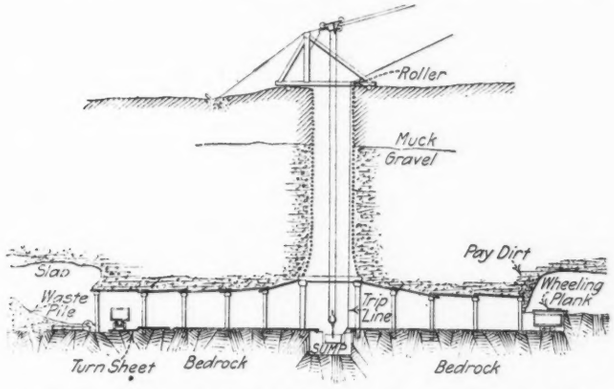

FIG. 4. GENERALIZED SECTION OF A PLACER MINE

are driven at top speed from morning till night. Very few members of the English-speaking nationalities are employed for work of this character. Russians, Scandinavians and natives of southern Europe make up the greater part of the shoveling gang, and the placer crew is comparatively homogeneous that does not represent half a dozen nationalities.

Shoveling the Most Important Operation

The output for each shoveler varies from 75 to 150 wheelbarrows per day of 10 hr., depending on working conditions, the length of trips and—chiefly—on the character of the gravel. For most mines the average ranges from 100 to 120, with the emphasis on the lower figure. In estimating working costs it is usually counted that a shoveler will strip from 30 to 35 sq.ft. of bedrock per day—equivalent to about 7 cu.yd. of material in place. The steady grind, day in and day out, is extremely hard on the crew and many are unable to stand the work. Some of the men have to force themselves to eat more than they want to keep from becoming hungry and weak a short time before noon and evening, and the scheme has been tried with moderate success of giving the shovelers a light lunch of coffee and doughnuts, pie, or cake at 10 a.m. and 4 p.m. The first Alaska Legislature, which met in 1913, established the 8-hr. day for all quartz mines, but the attempt to pass a similar law for placer mines was defeated by the members from Nome and Fairbanks. As was predicted at that time, the question came up at the second session and the law was extended to apply to placer as well as to lode mines. The new law is a step in advance, for no one who has worked alongside the shovelers of Fairbanks can deny that eight hours of such work is sufficient.

The No. 2 round-pointed shovels 5 ft. long over all are used and these are discarded as soon as the point becomes slightly rounded or the shovel wears so thin as to become too limber for efficient work. The life of a shovel, barring accidents, is from two weeks to a month. It is considerably less when shoveling plates are used than otherwise. Picks weighing 6, 7 and 8 lb. are used, the heavier ones being preferred at most mines. These are kept in good repair at all times and are laid aside for resharpening as soon as they become worn and dull. One man will dull from two to five or six in a shift, one for each half-day being a common allowance, with plenty of extras in case the point breaks or bends. Many picks are lost through carelessness on the part of the shovelers, who usually toss their dull picks behind them on the waste pile when taking sharp ones. These are often forgotten and are buried.

Shoveling to Clean the Bedrock

Bedrock gives the shoveler the most trouble. It is frequently tight and blocky and is difficult to remove, and there is a tendency for the green shoveler, in order to keep his turn, to remove the top gravel ahead of bedrock. Then when he comes to take up bedrock he finds that he has a tough proposition on his hands and must either drop out for a turn or two or must delay the rest of the gang. He soon learns that the easiest and most satisfactory way is to remove the bedrock first, undermining the gravel as shown in Fig. 3 until it caves onto the shoveling plate, when he may be able to work as much as an hour without additional picking. Some operators object to the use of shoveling plates on the ground that they wear out the shovels too rapidly and cause loss of time in leveling off for them and putting them in place. Where bedrock is composed of soft, decomposed schist through which the shovel can be pushed with ease there is some point to this objection, but for the great majority of mines—which have blocky bedrock—the use of plates is to be recommended. Fig. 4 shows a generalized section through a placer mine arranged to use cars at the downstream face and wheelbarrows at the upstream face.

Different Methods on Vault Creek

Different conditions on Vault Creek and its tributaries from those prevailing in the rest of the district have led to the development of a slightly different method of mining. The ground is deep—much of it being 200 ft. to bedrock—and the paystreaks are narrow and irregular. Owing to the time and cost of sinking, prospecting must be done with as few shafts as possible. Similarly, owing to the narrow paystreaks and the way they twist and turn, it is not feasible to drive long tunnels and crosscuts to prepare for stoping, as is the usual practice in the Fairbanks district. The first rule becomes "follow the pay," and it is often impossible to do this and keep the drifts straight. There is probably no other place in Alaska where ground stands as well after stoping as it does on Vault Creek and its most important tributary, Treasure

Creek. Slabs rarely form and when they do they are small and cause little trouble. These factors have combined to make it desirable to start the stopes near the shaft and carry them away from it in both directions. A pillar must of course be left around the shaft, but it need not be of great extent.

The method is illustrated in Fig. 5. The runways are kept open by timbering with three-piece sets and lagging tightly. If this is not done the waste that comes down with each new thaw must be shoveled away, and in time it accumulates in such quantity as to form a sort of large hopper with the wheeling-plank in the center and with sides reaching to the roof, as shown in Fig. 6. After this stage is reached all the gravel that falls over a wide area collects on the running-plank and must be removed by hoisting. Small timbers only are required, since they soon become covered on all sides with waste and confine much of the heat of the pipe line, thus insulating the frozen roof. Consequently the weight of the thawed gravel resting on the sets is comparatively slight.

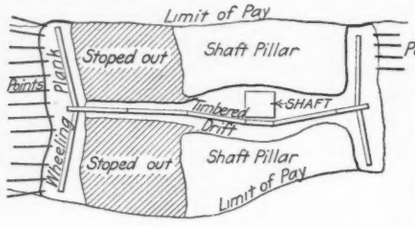

FIG. 5. METHOD OF WORKING AWAY FROM SHAFT

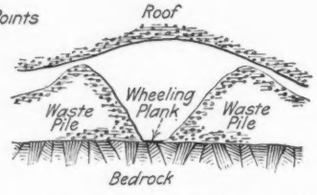

FIG. 6. WASTE ACCUMULATION ALONG UNTIMBERED RUNWAY

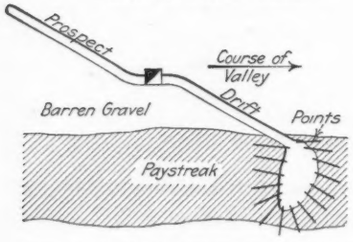

FIG. 7. VAULT CREEK METHOD OF PROSPECTING

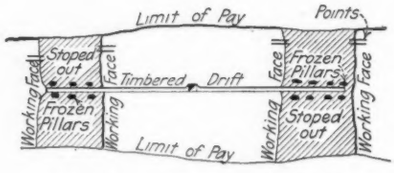

FIG. 8. COMBINATION METHOD FOR NARROW PAYSTREAKS

Wheeling Gravel on Bad Grades

Bedrock surface is irregular and in following it the floor of the tunnel rises and falls, making a variable grade. The pay is likely to swing from side to side and the drift must twist and turn in order to keep near the center of the paystreak. It is evident that this is one place where wheelbarrows for transport, on account of their greater flexibility, have a great advantage over cars and they are used almost exclusively. When, owing to lack of grade, water will not drain away from the face, it is removed by means of siphons and injectors. After a depression in bedrock has been crossed, however, it is gradually allowed to fill as the roof thaws, the wheeling-plank being raised correspondingly. Timbering is necessarily delayed in this case, but the advantages of having a runway of even grade through which the water will drain to the sump at the shaft outweigh this disadvantage. There is nothing, aside from working under a low roof, that tires a workman and decreases his output so much as wheeling up a grade. On the level he need only hold the handles of the wheelbarrow at the proper elevation and it virtually runs itself, but on an upgrade it is necessary to push from an awkward angle and on a steep downgrade it is necessary to hold back, which is hardest of all. Owing to the fact that most shovelers doing their own wheeling play out first in the wrists it is desirable to avoid wrist strain as much as possible.

Prospect shafts are usually sunk of such size as to be suitable for actual mining and if no pay is found at bedrock it is difficult or impossible to tell whether the pay-streak is toward the creek or toward the hill, or whether the shaft is merely in a low-grade area in the main pay-streak. Since the pay is often not rich enough to permit of much expense for prospecting and development—and this is one of the chief reasons for adopting the method of mining under discussion—every foot of work must be done with a view to possibilities for further use. Crosscuts are therefore not driven directly across the creek in looking for pay but are run diagonally so that they will serve as runways in case pay is discovered, one angling up the hill, the other toward the creek, as shown in Fig. 7. This serves to prospect the channel in all four directions at once. Although one drift will usually be in waste the operator generally considers himself lucky to have one face in good pay all the time.

Manchurian Iron Developments

An iron industry in Manchuria is to be built up by Japanese capital. Consul-General S. P. Heitzleman at Mukden writes that "among the nine mining areas in South Manchuria where Japanese are permitted, by an exchange of notes between the Japanese and Chinese Governments on May 25, 1915, to prospect for and operate mines, one of the largest and most promising is the iron mine in the Anshanchan region, between Liaoyang and Penhsihu, in the central part of Shengking Province." The extent of the deposits is said to equal that of the Hupeh mines. "The working of this mine is to be intrusted to the South Manchuria Ry. Co. The railway company will not confine its labors to mining ore, but proposes to manufacture iron as well. For smelting purposes neither Fushun nor Yentai coal is suitable, and it is said Penhsihu coal will be used. A site for the smeltery on the opposite side of the Penhsihu River which comprises about 83 acres of land has been chosen and the negotiations for its purchase are about concluded. The undertaking is to assume considerable proportions, and the capital for investment is estimated to be not less than $5,000,000."

A Process for Producing Tungsten Powder has been patented by Robert Rafn, of Porsgrund, Norway, and assigned to the General Electric Co., says "Engineering." The production of amorphous tungsten powder by reduction of tungsten trioxide is usually difficult of accomplishment, as a crystalline product most often results. The inventor has shown, however, that by making the reduction in two stages—first with ammonia gas at red heat, producing the so called blue tungsten oxide, and then with hydrogen at cherry-red heat—the resulting product is a tungsten powder of remarkable fineness.

Explosives Used in War and Metal Mining

By Percy E. Barbour

SYNOPSIS—Guncotton is the basis of the most important military explosive and of the second most important mining explosive. Benzol and toluol are important coal-tar products which furnish bases for manufacture of picric acid used in military explosives and nitro-substitution compounds used in low-freezing dynamites. Dynamites graded into five distinct classes, each of which has advantages and disadvantages. Low-freezing dynamites without ammonium nitrate give excessive amounts of noxious gases, and with ammonium nitrate are decidedly hygroscopic. Straight dynamite is best adapted for the widest range of work; gelatin dynamite for wet work. Least amount of obnoxious gases is given off by the gelatin dynamites. Correct explosives to use not determined by any fixed rule but by experience and judgment of the mining engineer.

Although the munitions of war are almost never used by the mining engineer (unless he happens to be operating in Mexico at present), and the explosives common to mining are only to a slight extent used in war, yet the requirements of the two have an inter-relation which is not distant. Dynamite, the commonest of mine explosives, is used in war only for demolitions, as in the case of bridges, structures, etc., and to a comparatively limited extent in the present war for the destruction of the enemy's trenches, and in hand grenades. But the basis of the most important explosive used in war and the basis of the second most important explosive used in mining is the same—guncotton—which is the essential ingredient of all smokeless powders, of blasting gelatin and of all gelatin dynamite.

Smokeless Powder and Guncotton

The manufacture of this explosive is complicated only from a mechanical standpoint. There are no chemical mysteries about it. Smokeless powder is also called nitrocellulose, the principal ingredients of which consist of cotton or cellulose, nitric acid, sulphuric acid, ether and alcohol.

Smokeless powder in the chamber of a gun is not intended to be detonated, but to be exploded by a progressive combustion, the result of which is determined by the characteristics of the gun or the service expected of it. The rate of the combustion depends upon the amount of surface exposed, hence the perforations which give this added surface to the powder grains.

Nitrocellulose is a general term applied to products resulting from the action of nitric acid on cellulose, in which the organic cellular structure of the original cotton fiber has not been destroyed. Guncotton is a nitrocellulose of high nitration, consisting of a mixture of insoluble nitrocellulose with a small quantity of soluble nitrocellulose, and a very small quantity of unnitrated cellulose. The chemical name for guncotton is tri-nitrocellulose, and the formula is $C_{12}H_{14}O_4\ (NO_3)_6$.

Owing to the fact that guncotton ordinarily contains a large percentage of water, it is most suitably adapted for use in military mines and submarine or other work of wet nature. Dry guncotton is used to detonate charges of wet guncotton. When dry it is very sensitive and is classed as a detonator and must be handled carefully, while wet guncotton, contrary to general impression, is one of the safest explosives to handle.

Nitrocellulose Compounds

In the manufacture of nitrocellulose, by varying the strength and the proportions of the nitric and sulphuric acids, their temperature and the length of time that the cotton is in them, a number of different products are obtained varying in the rate at which they will burn and the effects produced, and in the degree to which they are soluble in various solvents. This gives many different grades of explosives to which various names are applied at the will of the manufacturer and which are capable of a wide latitude of adaptability to different requirements.

Cordite is a British smokeless powder consisting of 37 parts of guncotton, 58 parts nitroglycerin and 5 parts vaseline. This powder gives a very high muzzle velocity with a low pressure in the powder chamber, but the temperature of its explosion is so high that it causes a rapid erosion of the bore of the gun. Therefore, another form of this powder known as Cordite M.B., in which the ratio of the guncotton and nitrogylcerin is reversed, has been made which overcomes these disadvantages. This illustrates the possibilities of different combinations of the same materials to effect different purposes.

Benzol and Toluol and Derivatives

Increased interest attaches to benzol and toluol at the present time on account of the number of plants being constructed to manufacture them. They are used in the manufacture both of dyestuffs and high explosives for war munitions. The United States Steel Corporation has three plants nearing completion—one at Farrell, Penn., one at Gary, Ind., and one at Birmingham, Ala. The Lehigh Coke Co. is building a benzol plant at South Bethlehem, Penn.; the Woodward Iron Co., Woodward, Ala., has a new benzol plant in operation; the Lackawanna Steel Co. has a benzol plant at Buffalo; and the Benzol Products Co., working with the General Chemical Co., the American Coal Products Co. and the Semet-Solvay Co., is building a plant at Marcus Hook, Penn., which will soon be in operation. The Dominion Steel Co. of Canada is manufacturing benzol on a large scale, and the Crows Nest Pass Coal Co. is also contemplating the building of a similar plant.

Benzol is a coal-tar distillation product comprising a mixture of benzene with variable quantities of toluene and other homologues of the same series. The Rittman process, of which we have heard so much lately, is a process whereby these products may be obtained from the distillation of petroleum, but at the present time they are only obtained commercially by distillation of

coal-tar products, principally as a byproduct from coke ovens. The product known as "crude benzol" is further fractionally distilled, and by this means separated into pure benzene, toluene and other true chemical compounds. Benzene[1] is C_6H_6 and toluene is C_7H_8. A 90% benzol is a product of which 90% by volume distills before the temperature rises above 100 deg. C. The composition of a 90% benzol is about 70 benzene, 24 toluene, and 4 to 6 of lighter hydrocarbons. Toluol is an impure form of toluene, so alike that the difference is only detected by a slight discoloration on the addition of sulphuric acid.

Toluene possesses the property of rendering oxygen very active and when treated with nitric and sulphuric acid and heated for several days yields tri-nitro-toluene, an explosive of a high order which is superseding the use of picric acid as a base for shell fillers for artillery use.

Tri-nitro-toluene and tri-nitro-toluol are practically the same, and have been abbreviated to trotol or t.n.t. in United States Army parlance. This explosive, trotol, is also used, especially for submarine mines and in the German 42-cm. guns and is, next to picric acid, the most terrific explosive in the service.

Picric Acid

Benzene, a redistillation product from benzol, is used in the manufacture of carbolic acid or phenol; this in turn is the basis of picric acid, which latter is the base of most of the high explosives used at the present time in the European conflict. When phenol (carbolic acid) is treated with nitric acid, a nitrate called tri-nitro-phenol is formed. Its only use is as an explosive. It is not only an explosive of itself, but more particularly is used as an ingredient of special explosive mixtures. Most of the new so-called shell-filler explosives are either picric acid or mixtures of picric acid salts called picrates. Among these are ecrasite (Austrian), lyddite (English), melinite (French), shimose (Japanese), etc. The exact compositions of these are secrets carefully guarded by the different governments.

The explosive used in the United States Army as a shell filler is known in the service as "Explosive D." This is a picric-acid derivative, the exact composition of which is maintained a secret by the Government. Its relative force of explosion is twice as great as that of guncotton, which of course is ample recommendation for its use in armor piercing shells.

Picric acid, although a powerful explosive, forms in connection with lead, iron and some other metals, some very sensitive and dangerous compounds. This is true to such an extent that it is dangerous to paint the interior of a shell—which is to be loaded with a picric acid derivative—with a paint which has either red or white lead in it, and it is also dangerous to use red or white lead in screwing in a shell plug. Trotol does not have this disadvantage, and it is for this reason that it is displacing, in this country at least, picric-acid explosives.

Dynamite

Dynamite is a general term for all high explosives composed primarily of nitroglycerin and some solid matter as an absorbent. Low explosives comprise the saltpeter mixtures, such as gunpowder, in which explosion is brought about by simple but rapid combustion, giving rise to a large volume of highly heated gases but leaving almost one-half of the original mass as a solid residue. In the high-explosive class, explosion is the result of the compound being wholly resolved into a large volume of highly heated gases, with little or no solid residue, the change taking place many times faster than the combustion in the saltpeter (KNO_3) class of low explosives. Low explosives exert a relatively slow pushing effect upon the substances on which they act at the moment of explosion, while high explosives, on account of the high rate and power of detonation, have a shattering effect upon the substances with which they are in contact.

Dynamite was originally invented as the result of an attempt to saturate black powder with nitroglycerin, in order to get a powder of increased intensity, it being inconvenient to use the nitroglycerin itself alone, as the explosive. The disadvantages of this early attempt were overcome by using kieselguhr as absorbent for the nitroglycerin and the original brand of dynamite was evolved. This original absorbent, base or "dope" as it is commonly called, was a porous, lightweight earth and added in no way to the explosive force of the nitroglycerin and remained as a solid residue after the explosion. If this dope is a substance which will neither burn nor explode, it is called an inactive base; if it will burn or explode it is called an active base, and may be either an explosive compound, a combustible compound, or a mixture of a combustible and an oxygen carrier. Experiment developed the fact that if a dope was used which was an active base, and which would either explode or furnish oxygen for the other explosives, the force of the explosion was greatly increased. It was also found that with an inactive base a dynamite containing less than 30% nitroglycerin could not be exploded, but with an active base a satisfactory explosive could be made containing as low as 5% nitroglycerin. If it were not for this fact the popular 5% nitroglycerin powder, sometimes called granulated nitroglycerin powder, largely used in quarrying operations, could not be detonated.

The character of this active base is possible of an almost infinite number of commutations, with an equal number of brands of dynamite possessing varying characteristics, and here is the labyrinth into which the mining engineer has been hopelessly plunged heretofore.

Nitroglycerin consists of glycerin, nitric acid, and sulphuric acid, and is made by allowing a small amount of glycerin to enter into the presence of the strongest acids, chemically pure, mixed in the proportion of two parts sulphuric to one part nitric.

Modern Grading of Dynamite

There are only five important grades of dynamite which need be considered in mining engineering work: Judson powder, straight nitroglycerin dynamite, ammonia dynamite, low-freezing dynamite, and gelatin.

Judson powder is a low-grade granulated nitroglycerin powder, containing about 5% nitroglycerin, which is used for quarrying or road work or railroad excavation. An average composition of such powder is 5% nitroglycerin, 35% combustible material composed of sulphur, coal and resin, and 60% sodium nitrate, the latter being used as an oxidizer. Except that this powder has nitroglycerin for its base, it would hardly count in the class of dynamite, as it so much more closely resembles

[1]Benzine is a distillation product from petroleum.

black powder, the composition of which is 16% charcoal, 11% sulphur, 73% sodium nitrate.

Straight nitroglycerin dynamite is graded according to the nitroglycerin content, which varies in commercial brands from 15 to 60%. The following compositions are given by analyses by the Bureau of Mines.[2]:

COMPOSITIONS OF STRAIGHT NITROGLYCERIN DYNAMITES OF VARIOUS STRENGTHS

Ingredients	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%
Nitroglycerin	15	20	25	30	35	40	45	50	55	60
Combustible material*	20	19	18	17	16	15	14	14	15	16
Sodium nitrate	64	60	56	52	48	44	40	35	29	23
Calcium or magnesium carbonate	1	1	1	1	1	1	1	1	1	1
	100	100	100	100	100	100	100	100	100	100

*Consisting of wood pulp, flour and sulphur for grades below 40%; wood pulp only for other grades.

In other than straight dynamites the trade rating is not a measure of the nitroglycerin content, as the following tables of ammonia and low-freezing dynamites will show, and other brands of dynamite of the same commercial rating have not been found to be equivalent in every respect to straight dynamite. The rating, 40% for instance, for more than one kind of powder of very different blasting properties, is an unfortunate and misleading one.

Straight Nitroglycerin Dynamite

An analysis of 40% straight nitroglycerin dynamite, quoted from Bureau of Mines Technical Paper 17, is as follows: Moisture, 1.45%; nitroglycerin, 39.46%; sodium nitrate, 42.62%; calcium carbonate, 1.11%; wood pulp, 15.36%; total, 100%.

Some form of oxidizer is necessary in an explosive. Saltpeter is the common ingredient of black powder for this purpose; five-sixths of its oxygen is available for oxidization and the nitrogen is given off in a free state. Sodium nitrate contains more available oxygen than the potassium salt and is more commonly used in dynamite, although at very high temperatures it exercises a less powerful action upon the other combustible ingredients. It cannot be used for ordinary gunpowder, because it is hygroscopic. Because this is so largely used in ordinary dynamite is one reason why the latter will deteriorate so rapidly if stored in a damp place, as for instance a wet drift underground. Calcium carbonate, magnesium carbonate or sodium carbonate are inert bases, which are added to the dynamite to neutralize any free acid present.

This explains the function of each of the ingredients of the ordinary straight dynamites shown in the analysis: Nitroglycerin is the explosive; wood pulp is the combustible absorbent; sodium nitrate (Chile saltpeter) the oxidizing agent; and calcium carbonate is the neutralizing agent.

Straight dynamite can be had in 75 and 80% strengths on special order but its use is almost always ill-advised. It is too sensitive both to shock and to friction to be transported safely and it gives off extreme amounts of obnoxious gases.

Nitroglycerin dynamites freeze at temperatures between 45 and 50 deg. F.

The ammonia dynamites are practically straight dynamites with part of the nitroglycerin replaced by ammonium nitrate. Sulphur is usually one of the constituents of this type of dynamite, and the wood pulp may be largely replaced with flour. The substitution of ammonium nitrate for the nitroglycerin has one slight advantage over the use of sodium nitrate, namely, that on explosion it goes completely into gas. Other than this, it has no advantage except to lower the cost of manufacture of the dynamite. It gives a weaker and less powerful explosive. Ammonium nitrate does have an advantage, however, in the manufacture of explosives for use in coal mines because on explosion a considerable amount of water is formed which lowers the temperature of all of the products of the explosion.

Ammonium nitrate is hygroscopic to such an extent that its use in military explosives has been entirely discontinued.

When ammonium nitrate is dissolved in some solutions a considerable amount of heat is absorbed and this property is utilized in many so-called freezing mixtures. Ammonia dynamite freezes at temperatures lower than straight dynamite and when some of the nitroglycerin is replaced with nitro-substitution compounds a low-freezing ammonia dynamite is obtained with still lower freezing point. The following tables from Bulletin 80, p. 23, Bureau of Mines, give the ingredients of these types:

COMPOSITIONS OF TYPICAL AMMONIA DYNAMITES

Ingredients	30%	35%	40%	50%	60%
Nitroglycerin	15	20	22	27	35
Ammonium nitrate	15	15	20	25	30
Sodium nitrate	51	48	42	36	24
Combustible material*	18	16	15	11	10
Calcium carbonate or zinc oxide	1	1	1	1	1
	100	100	100	100	100

COMPOSITIONS OF LOW-FREEZING DYNAMITES

Ingredients	30%	35%	40%	50%	60%
Nitroglycerin	13	17	17	21	27
Nitro-substitution compounds	3	4	4	5	6
Ammonium nitrate	15	15	20	25	30
Sodium nitrate	53	49	45	36	27
Combustible material*	15	14	13	12	9
Calcium carbonate or zinc oxide	1	1	1	1	1
	100	100	100	100	100

*Composition similar to that of the combustible material in straight dynamite of grades below 40%.

Low-Freezing Dynamites

Nitro-substitution compounds have been used as components of dynamite, particularly because they lower the freezing point of the nitroglycerin therein. The nitro-substitution compounds are substances derived from coal tar, after having been acted upon by nitrating solutions. These mixtures reduce the temperature of the freezing points to 35 deg. F., which gives the dynamite its type named. This low-freezing quality is the only advantage of this type of powder, which, like ammonia dynamite has a lower rate of detonation and hence less disruptive effect than straight dynamite. It also has the disadvantage of the deliquescence of the ammonium nitrate and cannot be stored in damp places. A typical analysis of the composition of low-freezing dynamite is quoted from Bulletin 80, p. 22 of the Bureau of Mines.

COMPOSITIONS OF LOW-FREEZING DYNAMITES

Ingredients	30%	35%	40%	45%	50%	55%	60%
Nitroglycerin	23	26	30	34	38	41	45
Nitro-substitution compounds	7	9	10	11	12	14	15
Combustible material*	17	16	15	14	14	15	16
Sodium nitrate	52	48	44	40	35	29	23
Calcium or magnesium carbonate	1	1	1	1	1	1	1
	100	100	100	100	100	100	100

*Composition similar to that of the combustible material in straight dynamite.

Nitroglycerin acts as a solvent under certain conditions to dissolve soluble nitrocellulose, and the mixture that

[2]Bulletin 48, p. 7.

forms will set to a jellylike mass. In this way, or by the use of other solvents, the explosive known as blasting gelatin is formed. This is rated at 100% nitroglycerin, meaning that the dope has absorbed an amount of nitroglycerin equal to 100% of its own weight. This is the most powerful explosive that transportation companies will accept for carriage, and while perfectly safe to handle, in fact much safer than straight dynamite above 40%, is altogether too violent for ordinary mining operations, although having a field all its own for special applications. This composition is diluted by mixing it with a dope such as nitrate of soda and wood pulp used in straight dynamite, and the mixture so formed is known as gelatin dynamite. This gelatin dynamite is made in various grades rated by per cent. strength, as are the straight dynamites. The reason blasting gelatin gives so much greater force is because it gets more complete combustion on explosion than any of the other dynamites, and this additional chemical action greatly increases the heat, hence the volume of the gases and the force of the explosion. The initial shock necessary to detonate blasting gelatin is six times greater than is required for dynamite. This applies in only a slightly less degree to the gelatin dynamites, which is the reason a stronger cap is necessary when using this type of explosive. Unlike straight dynamite, gelatin dynamite is very sensitive to shock when frozen. In its ordinary condition its sensitiveness is increased by heat, but under usual circumstances it is much less sensitive to shock and friction than straight dynamite is. Aside from the strength of this explosive the greatest advantage of this type is its almost complete combustion and hence the freedom from noxious gases after the explosion. The next great advantage is the fact that it can be used in the wettest kind of work. A cartridge placed in water will turn white on the surface, on account of the nitroglycerin in the outer layer being displaced. The nitrocellulose remaining forms a protective coating for the rest of the mass, and makes it practically waterproof. However, those gelatin dynamites of low grades which contain a large proportion of hygroscopic nitrate have this water-resisting quality to a less degree than those higher up the scale.

Gases from Explosion of Dynamite

Both the amount and the quality of the gases produced by the explosion of dynamite are of important consideration, because the effect of the explosives is directly due to the quantity of gas generated. Referring to the last column in the following table, it will be seen that 60% straight dynamite generates about 50% more gas than does 40% straight dynamite. The tendency to use 60% dynamite underground should be discouraged, because while it is true that it does have much greater disruptive force than 40% dynamite, it gives such a large volume of obnoxious gases that smoke troubles are likely to overbalance any advantage due to using this stronger explosive. The figures in this table are taken from a more elaborate one in Bulletin 48 by the Bureau of Mines, and the results are concisely stated in its Bulletin 80, p. 25, as follows: "The low-freezing dynamite produced on detonation larger volumes of poisonous gases than any other explosive tested, one sample of the gaseous products of combustion of a low-freezing dynamite containing 47.47% by volume of carbon monoxide. The straight nitroglycerin dynamite produced 26.9 to 34.6% of carbon monoxide; blasting powder produced 10.8% carbon monoxide, and 8.7% hydrogen sulphide; granulated powder produced 2.7% carbon monoxide, and 15.7% hydrogen sulphide; and ammonia dynamite produced 3.8% monoxide, and 5.4% hydrogen sulphide. The gelatin dynamite on detonation gave the least amount of poisonous gases, namely, 3.0% carbon monoxide and 4.1% hydrogen sulphide."

GASEOUS PRODUCTS RESULTING FROM TEST OF EXPLOSIVES*

Class and Grade of Explosive	Gaseous Products (% by Volume) Carbon Dioxide	Carbon Monoxide	Oxygen	Hydrogen	Methane	Nitrogen	Hydrogen Sulphide	Volume of Gas (Liters)
30% straight nitroglycerin dynamite	22.9	28.4	0.0	20.6	0.7	27.4	...	85.8
40% straight nitroglycerin dynamite	27.3	26.9	0.0	18.0	0.4	27.4	...	88.5
50% straight nitroglycerin dynamite	24.4	31.2	0.0	20.7	0.7	23.0	...	105.5
60% straight nitroglycerin dynamite	22.2	34.6	0.0	23.2	0.8	19.2	...	128.9
60% low-freezing dynamite	8.9	47.4	0.0	31.0	0.6	12.1	...	169.5
40% ammonia dynamite	41.4	3.8	0.0	3.1	0.8	45.5	5.4	65.6
40% gelatin dynamite.	50.8	3.0	0.0	1.8	0.8	39.5	4.1	60.3
5% granulated nitroglycerin powder	51.3	2.7	0.0	0.9	0.7	28.7	15.7	61.6
Black blasting powder.	49.7	10.8	0.0	1.8	0.6	28.4	8.7	67.8

*These explosives are not the same as given in the previous tables.

Summary of Characteristics

The straight nitroglycerin dynamite develops greater disruptive force than any of the other types of explosives, class for class, and where shattering effects are required should be used in preference to any other kind. Straight dynamite freezes at temperatures between 45 and 50 deg. F. The chief disadvantage in the use of straight dynamite is the considerable volume of obnoxious gases which are given off on detonation. These dynamites also are not suitable for use in very wet work.

Ammonia dynamite freezes at a lower temperature than the straight dynamite, and gives off less obnoxious and poisonous gases. It does not have the same strength as straight dynamite, grade for grade, is hygroscopic to an extreme degree and must be kept in perfectly dry storage or the deterioration is very rapid. Also it cannot be used in wet work. It is cheaper than straight nitroglycerin dynamite and is advisable for work where straight dynamite gives too violent an explosion. Ammonia low-freezing dynamite differs only from the above in that the freezing point is about 30 to 35 deg. F.

Low-freezing dynamite has practically the same advantages and disadvantages of the ammonia dynamite except that on detonation it produces the largest volume of obnoxious gases, and should not be used underground where the ventilation is poor.

Gelatin dynamite is the safest dynamite to handle and generates the least amount of obnoxious gases when detonated. It is the only dynamite to use in connection with wet work. It costs more than straight dynamite and does not give, grade for grade, the same disruptive effect, otherwise it would completely replace straight dynamite in mining work.

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Gold-Bearing Quartz Veins in Dutch Guiana

By J. B. Percival*

The gold-bearing quartz veins in Dutch Guiana, South America, have not yet been exploited to any great extent, although there are indications that with the necessary capital to open and develop them thoroughly, the veins will prove as rich as any in South America.

Three Distinct Gold Zones

The best-known quartz veins in the colony are in the first gold zone. There are three distinct zones—the first, about 50 mi. from the coast, the second, 100 mi. and the third, between 160 and 180 mi. These gold zones have an easterly and westerly direction and run practically through the whole country. The first zone, which embodies the Mindrinettie Creek district, has proved the richest so far, although on both the others rich ore has been discovered.

Up to the present in Dutch Guiana only the alluvial deposits have been extensively worked, but within the last year or two the quartz veins have been receiving attention. The large quantities of sharp-cornered quartz, lying about the hillsides, would show that it is in close proximity to its source. Lately, veins have been discovered showing visible gold on several properties. Portions, broken from the vein, are very rich. A large amount of the alluvial gold of the country comes from these quartz veins which have been broken down and eventually deposited in the creeks.

The best-known veins in the first gold zone are to be found on the Dejonge and Guyana Gould Placer concessions, where some of the veins have a thickness of 5 m. A geologist, who explored this part of the country and on his return to Europe published a paper entitled "A Brief Outline of the Surinam Gold Industry" said: "The most important part of the first gold zone examined by me is to be found between the Guyana Gould Placer Concession and Dejonge's property. The reefs continue their course along many hundreds of meters in an easterly and westerly direction. In the vicinity of the Guyana Gould property, the quartz veins are thickest and found at about a distance of 60 m. above the creeks and thus easily accessible. The gold percentage so far is remarkably high."

On the geological map of the colony the situation of these concessions is clearly shown to be slightly north of the fifth degree of latitude and west of a range of hills running from the Tempatie River across Bergendaal in an east-west direction. Most of the gneiss strata lie east and west and incline steeply toward the north.

The minimum level of this part of the colony is only 10 m. above Paramaribo, the capital; and, although the concessions mentioned are about 55 mi. from the coast, the altitude of the highest hill in the middle of these properties is but 500 m.

On the north, east and south of these concessions many good-looking veins are exposed for miles, and all that is required is capital to develop them. The railroad traverses the country and guarantees good communication with Paramaribo.

PROSPECTING PARTY BREAKING CAMP

MINING RICH QUARTZ IN DUTCH GUIANA

Quartz veins of different thicknesses are met with almost everywhere in the interior of Dutch Guiana. They do not, as a rule, take the same course as the steep gneiss formation, but notwithstanding carry more or less gold. A striking feature is the utter absence of basic and acidic eruptive rocks in some parts of the colony, which is not encouraging to those who maintain that the presence of similar rock formations is the cause of Dutch Guiana's gold wealth.

Farther south, that is to say, in the second and third gold zones, the country is very mountainous. Dutch Guiana is undoubtedly a rich country, and capital judiciously spent would make it a large producer.

Laboring men from temperate climes are not adapted to local conditions in Dutch Guiana. They could not exist on food of the kind supplied to the natives of the country, who are black and colored and earn only 50c. per 8-hr. day, with rations free. Black labor is good, comparatively speaking. When you can get a man to shift 300 cu.ft. of overburden, on the placers, in a day, it is good work, and of this the natives of Dutch Guiana are

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quite capable; but they must in every case be supervised by white men.

In regard to climate it may be safely said that, if white men from northern countries take proper and known precautions, no fears need be entertained. There are tropical inconveniences but the resident soon becomes habituated to them. It is probable that at no distant date Dutch Guiana will become an important gold center. What is now required is a better knowledge of local conditions by strangers abroad.

Manganese-Ore Supplies

One of the products that is essential in our steel industry, though its actual quantity is not so great as is generally supposed by those unfamiliar with the case, has been materially affected by the war conditions abroad. This is the manganese alloy which is used—generally in the form of ferromanganese—in both the converter and the openhearth furnace in making steel. The quantity of this alloy consumed for several years has been only about 1% of the total steel produced in the United States, but its use cannot be dispensed with, as no substitute has yet been found.

Difference Between Ferromanganese and Spiegeleisen

Two alloys of this kind are known familiarly in the trade, the difference being mainly in degree. The more important is ferromanganese, which has from 60% manganese up, the standard being 80%. This requires, of course, high-grade ore for its making. Spiegeleisen is lower in grade, the standard being 20 to 25% manganese, and can be smelted from ores which are more nearly manganiferous-iron than manganese ores. The use of ferromanganese is preferred and has been increasing for several years, while that of spiegeleisen has been declining.

The consumption of ferromanganese and spiegeleisen in the United States for three years past has been, in long tons:

Ferro:	1912	1913	1914
Domestic	125,378	119,495	100,731
Imported	99,137	128,070	82,997
Total	224,515	247,565	183,728
Spiegel:			
Domestic	102,561	106,980	76,625
Imported	1,015	77	2,870
Total	103,576	107,057	79,495

For the eight months ended Aug. 31, 1915, the total ferromanganese and spiegeleisen made in this country was 132,517 tons, which would indicate a total production of more than 200,000 tons for the year, notwithstanding the supposed scarcity of ore.

The sources of the raw material for our domestic product have been as follows, for three years:

Imports:	1912	1913	1914
Russia	83,334	124,337	52,680
India	128,645	141,587	103,583
Brazil	81,580	70,200	113,924
Other countries	7,102	8,966	13,107
Total	300,661	345,090	283,294
Domestic production	1,664	4,048	2,635

The ore from other countries was chiefly from Cuba. The total imports of ore in the half-year ended June 30, 1915, were 58,148 tons, being 76,433 tons less than in the corresponding period of 1914. The domestic production for several years past has been rather less than 1% of the ore used in our furnaces. The excess of foreign ore used has not been altogether because of the scarcity of domestic ore. The necessity of crushing and concentrating most of our ores and the cost of transportation have discouraged attempts to compete with foreign ores which had the advantage of cheaper mining, of little or no cost of preparation and of cheap water freights. No one anticipated the time when supplies might be cut off, and the consideration was only for present profit, not for provision for the future.

War and Manganese Shipments

The war in Europe introduced new and unexpected elements into the question. The exports of manganese ore from the Caucasus were cut off altogether, while those from British India were prohibited for a time, and when the strict embargo was raised, they were seriously restricted in quantity. The only free source of ore left was in Brazil, and to increase shipments from that country it was necessary to enlarge mining facilities, which required time and money. The ore resources in that country are large, but have never been properly developed.

Of course the immediate result of these conditions has been a strong advance in the prices of ore and of manganese alloys. Ferromanganese, the alloy most used in steel making, was quoted in the first half of 1914 at $36 to $38 per ton at Baltimore, where most of the foreign metal is imported. The current quotation is up to $105, Baltimore, for early delivery, while there have been sales of domestic ferro as high as $112.50 per ton, or three times the price a year ago. Ore has advanced in like measure. The Carnegie Co. bought in 1914 domestic ores on a schedule which made 26c. per unit of manganese for 49% ore the highest price, and this was understood to be a higher figure than was paid for imported ore, the company desiring to promote domestic production.

At the present time 45c. per unit is being named for 48% ore, while limitations as to silica and phosphorus are not as strict as they were. It is understood that the Brazilian ore that the Steel Corporation is now importing costs from 41 to 42c. per unit at seaboard, the ore running from 45 to 48% manganese, and being low in phosphorus.

Naturally there is a good deal of talk about prospecting for manganese ores and about reopening and developing old mines. The time is favorable, but so far there has been no large source of these ores brought to the point of commercial production.

New German Copper Refinery

A new German electrolytic copper-refining plant is to be installed, according to the London *Electric Review*. It is announced that the Hüttenwerke Niederschonweide proposes to erect a plant in the vicinity of Bitterfeld for the production of electrolytic copper. The energy required is estimated at 2,000,000 kw.-hr. per annum, which would be obtained from the Electro Works Co., of Golpa Jessenitz. The carrying out of the scheme would increase to three the number of works turning out electrolytic copper, the two existing being those of the North German Refinery Co. and the Kayser Metal Co.

Tin-Ore Dressing at Llallagua, Bolivia--II

By Durward Copeland* and Scovill E. Hollister†

SYNOPSIS—To separate the pyrite from the valuable cassiterite in the sulphide ore at Llallagua, Bolivia, roasting and magnetic separation were applied, following jig-and-table concentration. Kauffman 5-hearth mechanical furnaces and Stern wet-type magnetic separators have replaced hand furnaces and buddles.

As can readily be appreciated the production of *barrilla* from the pyrite-cassiterite middlings by means of hand furnaces and buddles was expensive at Llallagua, Bolivia, both because of the high-priced fuel and the large number of laborers—even though the labor is cheap—that were required. Because of this high cost, and because the hand furnaces were inadequate to handle the larger amount of fine pyrite-cassiterite middlings resulting from the treatment of a constantly increasing percentage of pyrite ore from the mine, automatic roasters and magnetic separators were installed. This installation is handling all of the fine middlings produced and the hand furnaces and buddles are now but interesting relics of the past.

Roaster-Magnetic-Separator Installation

The only problem the roaster-magnetic-separator plant must solve at Llallagua has to do with the treatment of pyrite-cassiterite middlings consisting of grains of small diameter. In these middlings the minerals have been broken free from one another, but a separation was not made by the water-concentrating machine of the mill. This does not mean that a reasonably good separation on classified material cannot be made between cassiterite and pyrite. On a table, for example, even with reasonably good classification it is difficult to make a high tin recovery without including in the concentrates so much pyrite that the sulphur becomes high enough to cause smelter penalties. The roasting furnaces employed to prepare the ore for the separators use no fuel except the sulphide in the ore, therefore, on the tables it is the practice to attempt no direct *barrilla* but to cut in with the band of tin enough of the band of pyrite to give concentrates with at least 25% sulphur as pyrite. The roasters require about 25% sulphur in order that the charge shall be self-burning (the furnaces are 13,000 ft. above sea level). The material, therefore, which the magnetic-separator plant has to treat is pyrite-cassiterite middlings with 25% or more of sulphur, usually containing at least 15% of tin, and nearly all of the middlings are finer than 1 mm.

The middlings are first taken to a drying floor of concrete, where the material is spread and raked over by hand until a greater part of the moisture has evaporated. There is still in the ore as it goes to the furnace feeder about 5% moisture. Five Kauffman furnaces, made by the Erzröst Gesellschaft of Frankfort-am-Main, Germany, prepare the ore for the magnetic separators. The Kauffman furnace used is of the five-compartment type, similar in general design to the McDougal furnace so common in American roaster practice. To cool the center shaft, air is supplied by a small fan. The air for burning the sulphide is regulated by an exhaust fan and adjustable air inlets in the furnace. Each of the furnaces has an iron pipe connection to a dust chamber, situated between the furnaces and the exhauster. From each of the furnaces the ore is delivered into a short conical trommel of unperforated sheet iron. The trommel serves two purposes: (1) To make constant the feed to the separators, and (2) to cool the ore somewhat. The ore leaving the trommel is hit by a stream of water which carries it through wooden launders to the magnetic separators. The separating machines are of the Stern wet type and were made by the Electro Magnetische Gesellschaft, Frankfort-am-Main. The nonmagnetic material is, if the feed is right, *barrilla* of sufficiently high tin percentage for exportation. In case there is an excessive amount of nonmagnetic material that is not tin, in the product the concentrates are re-treated on tables before shipping. The magnetic material is sent to the Hardinge mill for regrinding and from there to classifiers and tables.

No Carbonaceous Fuel Required

This plant is unusual in a number of ways. The ore is prepared for the separators by a furnace using no carbonaceous fuel. Therefore, since the magnetic oxide cannot easily be obtained, the problem is to roast to the magnetic sulphide. The "flash roast"—where the ore is passed through the furnace rapidly, and the bulk of the heat comes from the burning of carbon fuel, and where this heat drives off a part of the sulphur of the pyrite—is not applicable here. When the carbon fuel is used it makes no difference whether the sulphide burns or not, since the heat itself will drive off enough of the sulphur of the pyrite to make the resulting iron sulphide magnetic.

At Llallagua the heat to keep the furnace above the ignition temperature of the pyrite must come from the burning of a part of the sulphide itself. We have carried on extensive experiments to find which is the best degree of roast to make an iron mineral of the greatest possible magnetic permeability. The simplest method of regulating this is to control the percentage of sulphur in the furnace product. Our ores average about 27% sulphur and the best results are obtained when the furnace product still contains 10 to 12% sulphur. It would undoubtedly be more satisfactory, in case the furnace feed varied greatly in the amount of pyrite contained, to regulate the operation by the amount of sulphur in the magnetic part of the separator discharge. When working best the magnetic material from the separators contains about 22% sulphur and 50% iron, while the nonmagnetic part has about 1.5 to 2% sulphur and 2.5% iron. The roasted ore should be black and of metallic luster. In case the roast

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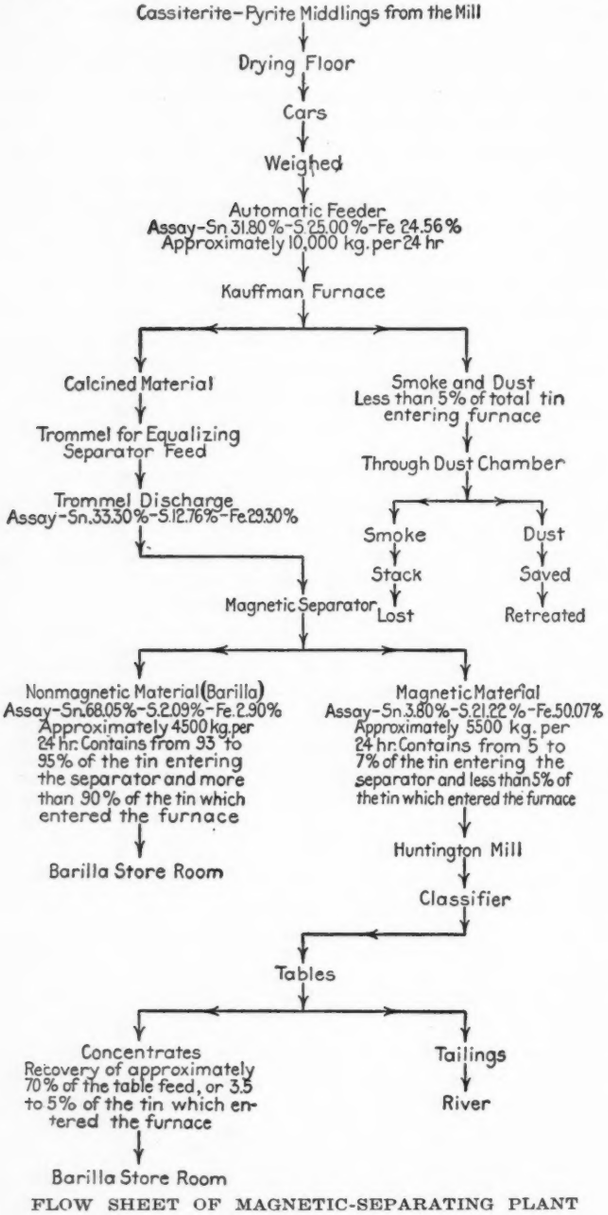
has proceeded far enough to give to the product a reddish color the separators do poor work and the *barrilla* runs up in iron.

Magnetic-Separator Work Dependent on Satisfactory Roast

It is, of course, true that the entire success of the magnetic separation depends on the work done by the furnaces. If the roast is properly made the magnetic machines must work well, while if the iron mineral is not


Cassiterite-Pyrite Middlings from the Mill
Drying Floor
Cars
Weighed
Automatic Feeder
Assay-Sn 31.80%-S 25.00%-Fe 24.56%
Approximately 10,000 kg. per 24 hr
Kauffman Furnace
Calcined Material
Smoke and Dust
Less than 5% of total tin entering furnace
Trommel for Equalizing Separator Feed
Through Dust Chamber
Trommel Discharge
Assay-Sn.33.30%-S.12.76%-Fe.29.30%
Smoke
Dust
Stack
Saved
Magnetic Separator
Lost
Retreated
Nonmagnetic Material (Barilla)
Assay-Sn.68.05%-S.2.09%-Fe.2.90%
Approximately 4500 kg. per 24 hr. Contains from 93 to 95% of the tin entering the separator and more than 90% of the tin which entered the furnace
Magnetic Material
Assay-Sn.3.80%-S.21.22%-Fe.50.07%
Approximately 5500 kg. per 24 hr. Contains from 5 to 7% of the tin entering the separator and less than 5% of the tin which entered the furnace
Barilla Store Room
Huntington Mill
Classifier
Tables
Concentrates
Recovery of approximately 70% of the table feed, or 3.5 to 5% of the tin which entered the furnace
Tailings
River
Barilla Store Room

FLOW SHEET OF MAGNETIC-SEPARATING PLANT

made sufficiently permeable during the roast the separators cannot make clean *barrilla*. It is undoubtedly true, also, that the highest temperature prevailing in the furnace is of great importance because of its effect on the reactions that can take place. With a regular feed and air supply, the sulphur percentage is the most convenient means of regulation. Our furnaces will roast about 10 tons each per 24 hr. when preparing the ore for the separators, that is, roasting from about 27% sulphur down to 10%. This is about 400 kg. per sq.m. of hearth area. It should be remembered that the furnaces are 13,000 ft. above the sea, that the greater part of the feed passes 1 mm. and that when entering the furnace the feed contains 5% moisture. If a quantity greater than that mentioned is fed, the furnace soon gets cold, more air simply aiding in the cooling. It is possible that with more rapid stirring and more air the furnace capacity could be increased. Our furnaces have two rabbles per compartment and the center shaft makes 3 r.p.m.

The amount of flue-dust made by the furnaces is surprisingly small when the fineness of the material treated is considered. Ordinarily the flue-dust produced is less than 5% of the weight of the furnace feed. The percentage of tin is always much less in the dust than in the feed. When the ore has 20% tin the material caught in the dust chambers never contains more than 5% tin, so the loss in dust is small; such loss never amounts to more than 2% of the tin charged to the furnace. The draft through the furnace is not particularly strong. The cassiterite does not decrepitate. All of the material which enters the furnaces is sufficiently heavy to be caught in water-concentrating machines. Under the conditions mentioned one would not expect to find in the flue dust much of a mineral which does not change either chemically or physically during its passage through the furnaces.

Trouble from Arsenic Condensation

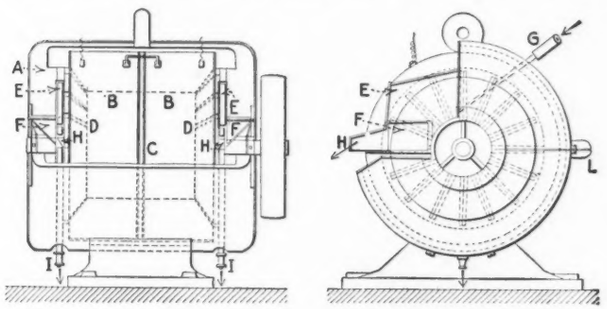
With the furnace installation as made at Llallagua there are some difficulties due to the fact that the design seems to have been made without a good knowledge of ores and conditions. Each of the furnaces is connected with the dust chamber by a sheet-iron pipe 80 cm. in diameter and 8 m. long. In the sulphide middlings treated there is always some arsenopyrite. During the roast a large part of the arsenic volatilizes as arsenious oxide. The sheet-iron pipe mentioned is of sufficiently low temperature to allow some of this arsenious oxide to condense, and every month there must be a cleaning of the pipe. Much of the arsenic fume passes the dust chamber and condenses in the exhaust fan. At present this fan has to be cleaned of the rock-hard oxide of arsenic once in every six weeks. We have installed two exhaust fans, one of which is always in operation. To drive the fan requires from 7 to 10 hp., depending upon the amount of arsenic that has been condensed, and this power costs at least 15 bolivianos per day (1 boliviano = approximately $0.39). With a stack of sufficient height, enough air could easily be obtained without the fan. The fan may be necessary for the regulation of air in sulphuric-acid making but is not needed in our roast and should not be installed at a place where power is so expensive. The cost of a proper chimney would be small as compared to the operating cost of the fan, and such a chimney will soon be constructed at Llallagua.

Stern Wet Magnetic Separators

The Stern type of separator is particularly adapted to the problem at Llallagua where the only material on which the magnetic machines are needed is the fine jig middlings and table concentrates. At the mines of Señor Patiño, in Uncia, there has recently been installed a large magnetic-separator plant using Humbolt-Wetherill machines; preceding these machines with screens such as might be found in a pyrite-blende separator in the United States.

The reason for the magnetic separators on the tin ores of Llallagua and Uncia is to do work which the mill could not easily perform. The mill did not complete the separation because classification was difficult on account of the fineness of the material. We can, therefore, see no reason for following the water end of the mills at Llallagua or at Uncia with another plant requiring classification and working poorly on fine ore. The gravity difference of two is sufficient to enable the mill to make a first-class separation of the cassiterite from the pyrite in the coarse ore. The wet separators used at Llallagua treat the whole product and work well on unclassified and fine-diameter feed.

A sketch of the Stern separator is shown herewith. The magnetic field is obtained by passing the electric current through the stationary coils *B* inside of which the iron core *C* revolves. Attached to the revolving iron core *C* are the flanges *D* which are beveled at the ends to concentrate the magnetic lines. The chambers *E*, in which the separation takes place, are between the revolving flanges *D* and the cast-iron body *A* of the machine. The roasted ore mixed with water, after passing a small sta-



STERN WET-TYPE MAGNETIC SEPARATOR

tionary screen to remove occasional large pieces which might clog spigot *I*, enters the separating chamber at *F* and is immediately subjected to the magnetic field. The nonmagnetic material, in this case the cassiterite, falls to the bottom of the separating chamber and passes out through the spigot *I*. That material of the feed which has sufficient permeability is raised above the water level of the separating chambers until finally it is hit by a stream of water from the jet *G* and is washed out of the machine through the spout *H*. To enable the stream of water from *G* easily to wash out the magnetic material, the field strength is lessened by having a segment cut out of the cast-iron body *A*. During the time the magnetic material is being raised out of the water the action of the lines of force, due to the revolving flanges, causes the material to turn over and over and gives good opportunity for entangled nonmagnetic particles to escape. The separating chambers are kept so full of water as to cause a constant overflow at *L* in order that the water may retard a rapid fall of the feed through the magnetic field.

Separators Require Little Power

The strength of the field may be easily varied by changing the strength of the current through the coils. Ordinarily at Llallagua about 6 amp. per machine is employed, the voltage being 110, which means about 1 hp. per machine. The revolutions of the flanges *D* may be increased or decreased, the effect being opposite to the same changes of the belt speed of an ordinary belt type of separator. The speed found best at Llallagua is about 14 r.p.m., but this can be varied according to the amount and class of the ore being treated.

The Stern separator occupies a floor space of 3½x3 ft. and the height from the entrance of the feed to the spigot *I* discharging the nonmagnetic material is 26 in. The capacity of the Stern separator on the fine-grained material treated is about 18 tons per 24 hr. Three separators can be used to handle the product from the five roasting furnaces, which leaves one separator always in reserve. The quantity of water needed for the separator varies with the amount and nature of the feed, it being necessary to have the water in the separating chambers always at the level *L*. Ordinarily about 2 cu.m. of water per hour are used with the feed to one machine and as much more for each separator to wash out the magnetic material.

The separators have given little trouble. About the only difficulty has been with the separating chambers. The side of the separating chamber next to the revolving flanges was, as supplied by the makers, made of steel containing enough nickel to be nonmagnetic, the idea being to have this necessarily nonmagnetic material sufficiently hard to resist the mechanical wear. In our ores there is always a little chalcopyrite and during the relatively low temperature roast some of the copper forms sulphate. The nickel-steel plates rapidly precipitated this soluble copper and the side of the separating chamber was soon destroyed, the wear being more chemical than mechanical. The nickel-steel has been replaced by copper plates and this trouble overcome. A separating chamber now lasts at least six months and can frequently be soldered to go a few months more.

Relation of Tin and Nonmagnetic Gangue

The most important point to take care of, if a *barrilla* rich in tin is to be obtained, is the relation between the tin and the nonmagnetic gangue in the furnace feed. If the percentage of nonmagnetic gangue is more than about one-fourth of the percentage of tin it is impossible to obtain 65% *barrilla* even if all of the iron mineral be removed.

The commercial results of the separator installation are good as compared with those obtained by the use of the old hand furnaces and buddles. With the hand furnaces the *barrilla* cost was about 1.90 bolivianos per quintal while the Kauffman-furnace magnetic-separator installation on the same material, produces a quintal of *barrilla* for 1.18 bolivianos.

The first cost of the Kauffman-furnace installation including the furnaces, freights, building, transmission, motor, fans, erection and all accessories was 160,000 bolivianos ($55,000) of which the total first cost of the furnaces in Europe was 24,000 bolivianos. The separator installation complete cost about 60,000 bolivianos ($21,000).

Three men per shift are required in the roasting department and three during the day to dry the ore and bring it to the furnaces. The separators use two men per 12-hr. shift although one man could do the work.

(*To be concluded*)

Superphosphate Is to Be Produced in the district of Slobodsk, Perm Province, Russia. The Department of Agriculture is aiding the local zemstvo in the enterprise.

Details of Practical Mining

Skip with Cable Guides

By Jesse Simmons*

A self-dumping skip operating on cable guides has been installed by E. R. Graham, superintendent of the Mogul Mining Co., Terry, S. D. The illustrations show the skip in dumping position at the top and a closer view with the skip hanging from the crosshead.

Dumping is accomplished by two hooks attached to the bottom of the skip, engaging a piece of 2-in. steel shafting that lies on the horizontal timber extending out to the left about half way up the headframe. Two bars

FIG. 1. SKIP IN DUMPING POSITION

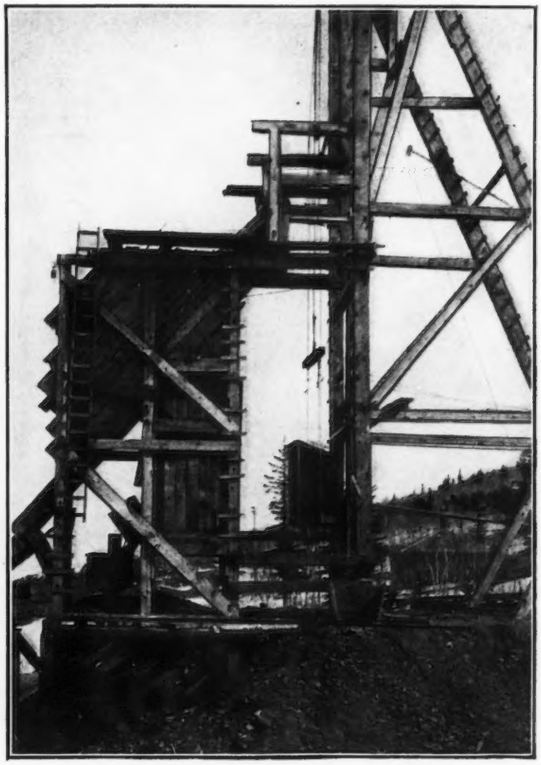


FIG. 2. SKIP READY TO LOWER

are fastened to this shafting at right angles to it and are provided with hinge connections so that the shafting is pushed up and out of the way by the skip coming upward. The shafting immediately drops into position when the skip bottom has passed; the engineer then drops the skip on the shafting, which is a few inches to the side of the center of the skip and causes it to tip. The hooks then engage the shafting and prevent its falling. The lip of the skip drops over until it rests on a timber. After the skip has dumped the engineer pulls it up quickly; the hooks in disengaging cause the skip to swing, and while it is swinging it is quickly dropped past the shafting. It is then stopped for a second or so, until it ceases swinging and is then lowered to the station at the bottom to be loaded. The cable guides are ¾-in. steel ropes.

Channel iron, ½x6 in., was used for the crosshead, two pieces being bolted together, with wood between. At each end 1-in. holes were bored to permit the guides to pass through. From the crosshead the skip is suspended by two short pieces of cable. The guides are fastened at the top to the headframe and at the bottom pass through I-bolts in heavy sills. The skip has a capacity of 1,800 lb. of rock—the load of a single mine car. The engineer finds it comparatively easy to hoist 50 to 75 skips per 8-hr. shift, besides having time to assist the blacksmith, repair the five or six stoping drills used underground and do other odd jobs.

The shaft is 135 ft. deep to the present loading station, and for the first 30 ft. only, is timbered with square sets; the remainder of the shaft is plank-lined. The rock is mostly a hard, firm shale, with some sandstone, lying nearly horizontal and having but a slight tendency to slough or cave. The shaft was sunk at a moderate expense, requiring considerably less excavation than if it had been planned to be timbered fully. It is one of the principal sources of ore supply for the company's mill. At the left in Fig. 1 may be seen a C., B. & Q. R.R. car being loaded for shipment to the mill. Waste is handled through the bin under which the mine car is seen standing. At present waste is used for stope filling.

*Deadwood, S. D.

The Bonus System Applied to Tunnel Driving*

The rapid advance made on some of the recent "record" tunnels, notably the Mount Royal, Arizona Copper, St. Louis Water-Works, Laramie Poudre, and Los Angeles Aqueduct, seems to have been due very largely to the bonus system of wages. This system was used at all the tunnels mentioned, and is the only practice of note that was common to those five contracts. Different types of drills, some with and some without carriage mountings, both long and short rounds, and different methods of handling the muck were used.

The cost of tunnel driving varies with the rate of progress. The saving realized by the bonus system in the labor cost is shown in the tabulation:

LABOR SAVING BY BONUS SYSTEM

	Per Cent.
Mount Royal Tunnel	15
Arizona Copper Tunnel	20
St. Louis Water-Works Tunnel	50
Laramie Poudre Tunnel	31

The cost of driving the tunnels during the record months under the bonus system has been compared with the cost of driving before the bonus system was adopted. Before considering the several projects separately the accompanying tables should be examined. Table 1 gives some general data as to character of rock, size of heading, etc., while Table 2 shows the approximate number of men at work.

TABLE 1. DATA OF TUNNELS WHOSE RECORDS ARE COMPARED

	Mount Royal Tunnel	Arizona Copper Tunnel	St. Louis Water-Works Tunnel	Laramie Poudre Tunnel
Rock	Trenton limestone with igneous dikes	Granite porphyry; good drilling	Both hard and soft limestone	Moderately hard, gray or red granite
Size of tunnel heading	8x12 ft.	8x8 ft.	8 ft. diameter (circular)	7½x9½ ft. (elliptical)
Average cross-section	3.56 cu.yd. per ft. advance	70.04 sq.ft.	95 sq.ft.	62 sq.ft.
Record advance in 31 days	810 ft.	799 ft.	745 ft.	653 ft.

TABLE 2. TOTAL LABOR ON TUNNEL CONSTRUCTION

	Mount Royal Tunnel	Arizona Copper Tunnel	St. Louis Water-Works Tunnel	Laramie Poudre Tunnel
Superintendents	2	..	1	1
Foremen or bosses	3	1	3	3
Drillers and helpers	24	12	24	15
Muckers	24	15	22	18
Miscellaneous labor of all classes	59	12	51	22

The bonus paid to the men at the Mount Royal tunnel was 7% of their daily pay for every foot over 14 ft. per day. The influence of the bonus system on the work at this tunnel is shown by Table 3.

TABLE 3. MOUNT ROYAL TUNNEL

Costs	A Typical Month Without Bonus	Record Month With Bonus
Labor	$9,989.00	$15,883.00
Equipment and supplies	2,927.00	4,750.00
Total, including overhead	13,916.00	21,633.00
Advance	434.00	810.00
Per foot (labor)	$23.00	$19.61
Per foot (labor, equipment and supplies)	29.76	25.47
Per foot (total)	32.06	26.70
Per cubic yard (labor)	6.48	5.51
Per cubic yard (total)	9.00	7.51
Saving (in labor) in cost per foot, by bonus system	....	3.39
Saving (in labor, equipment and supplies) per foot	....	4.29
Saving (total) per foot	....	5.36
Saving in total cost per cubic yard	....	1.50

At the Arizona Copper tunnel the men received regular wages, and for every foot of advance over 350 ft. per month a bonus of $7 was divided. This was only a trial, but although it was found that the bonus was excessive, it was not reduced, as the duration of the test was short. The tunnel was driven the first month without a bonus and the three succeeding months with a bonus. A comparison of the advances and the costs per foot of tunnel in each case is shown by the figures in Table 4.

TABLE 4. ARIZONA COPPER TUNNEL

Costs	Without Bonus First Month	With Bonus Second Month	With Bonus Third Month	With Bonus Fourth Month
Labor	$3,773.00	$5,314.24	$5,802.69	$6,574.77
Equipment and supplies	2,013.33	2,013.33	2,013.33	2,013.33
Labor, equipment and supplies	5,786.33	7,327.57	7,816.02	8,588.10
Advance in feet	350	582	664	762
Per foot (labor)	$10.78	$9.13	$8.74	$8.63
Per foot (labor, equipment and supplies)	16.53	12.59	11.77	11.27
Cubic yards of rock removed, labor, equipment and supplies	6.33	4.82	4.51	4.32
Saving on labor, per foot, by bonus system	....	$1.65	$2.04	$2.15
Saving on labor, equipment and supplies, per foot	....	3.94	4.76	5.26
Saving on labor, equipment and supplies, per cubic yard	....	1.51	1.82	2.01

Three shifts per day were employed at the St. Louis Water-Works tunnel. A minimum advance of 72 ft. per week was set, and for all over that amount the following bonus rates were paid: Superintendent, 50c. per ft.; heading foreman, 50c.; muck foreman, 30c.; drill runners, 30c.; drill helpers, 20c.; nipper, 20c.; muckers and cage men, 10c. Each shift was credited with one-third of the extra progress and received one-third of the bonus.

TABLE 5. ST. LOUIS WATER-WORKS TUNNEL

Costs	Estimated Cost per Day Without Bonus	Cost per Day With Bonus
Labor	$381.75	$381.75
Total bonus per day	.....	66.80
Advance, feet per week	72	745
Labor per foot	$37.09	$18.66
Labor per cubic yard rock removed	10.54	5.30
Saving in labor, per foot, by bonus	.....	18.43
Saving in labor, per cubic yard, by bonus	.....	5.24

Three shifts per day were employed on the Laramie Poudre tunnel. For the first part of the work each underground workman was paid a bonus of 25c. per day for each 25 ft. in excess of 400 ft. per month. This system was soon discontinued, as it was found to be not only cumbersome but excessively high, and the following system was adopted: When the rate of driving for any calendar month exceeded 400 ft. and was less than 500 ft., each underground employee was paid $10 extra; between 500 and 600 ft. the bonus was $15, and between 600 and 700 ft. it was $20. In order to distinguish the bonus money from the regular wages the bonus was paid by check. The itemized account is given in Table 6.

TABLE 6. LARAMIE POUDRE TUNNEL

Costs	Estimated Cost per Day Without Bonus	Cost per Day With Bonus
Straight wages	$242.65	$242.65
Total bonus per day	.....	29.68
Advance per month in feet	400	653
Labor, per foot	$18.76	$12.94
Labor per cubic yard removed	8.16	5.60
Saving per foot due to bonus	.....	5.82
Saving per cubic yard due to bonus	.....	2.56

The bonus system at the Los Angeles Aqueduct tunnels proved to be a great success, and all tunnels here were driven under this system. The bonus was shared by the tunnel foreman, shiftboss, miners and muckers. All back-trimming was done by the crew, which shared the bonus. Overbreakage was about 30%.

The bonus varied from 20c. to 40c. per ft. over the base rate, depending on the class of material encountered. At the start it was estimated that a reasonable progress

*J. R. McFarland, 5710 Kimbark Ave., Chicago, Ill., in "Engineering News," Aug. 26, 1915.

would be 8 ft. per day with three 8-hr. shifts. A bonus system based on this advance gave 40c. per ft. in excess of the 8 ft. Thus it was expected that the monthly advance would not fall below 248 ft.; as a matter of fact, 10.8 ft. per day was averaged, giving a monthly progress of 330 ft. The standard tunnel crew consisted of 16

TABLE 7. DAILY COSTS, LOS ANGELES AQUEDUCT TUNNELS

Average daily progress	10.8 ft.
Average cost, direct charge	$51.10
Equipment	6.50
Pipe lines and operation	.46
Roads, trails and maintenance	1.40
Buildings	1.49
Surveys	.24
Division administration	2.12
Executive administration	1.92
Miscellaneous losses, test, phone, operation, etc	.53
Grand total cost per foot of tunnel	$65.76

men in untimbered tunnels and 23 men in timbered tunnels. In dry tunnels miners received $3 per day and muckers and timbermen $2.50 per day; in wet tunnels each man received 50c. more per day. The itemized account is given in Table 7.

Track Ropes for Tramways*

There are two main types of rope which are used as track cables in aërial tramways—the spiral and the locked-coil construction. The main advantage of the spiral type is its cheapness, and in lines transporting a small tonnage per hour it will generally answer the purpose. When, however, a larger tonnage and the consequent heavier carriers enter into the question, its disadvantages begin to be apparent. The runner wheels passing over this type of rope come in contact with it only at one point of each of the top wires, whereby the wheels have grooves rapidly cut into them and the wires themselves begin to wear and commence to break. In order to overcome this difficulty, spiral ropes are generally made of a material having a higher breaking stress than that of the material used for locked-coil rope. A further disadvantage of spiral rope is that moisture penetrates between the individual wires and rusting occurs, thus shortening the life of the rope. Rope composed of several strands surrounding a hemp core is sometimes employed, but is not to be recommended as the individual wires are apt to break because of their small diameter. Spiral rope of the usual type should consist of 19 wires in ropes of 1 in. diameter and of 37 wires in ropes up to 1½ in. diameter.

Above 1½ in. diameter, locked-coil rope should invariably be used. To obtain the required diameter of the carrying rope, various makers employ different formulas. It may be obtained from the usual formula for the tension in ropes, but it has been proved by experience that much trouble is caused by breaking in consequence of the bending near the saddles, and for this reason many firms employ formulas based upon stresses resulting from bending. The formula used by Pohlig, of Cologne, is:

$$\textit{Weight per meter of rope} = \frac{0.85}{100}[\textit{weight of carrier} + (\textit{distance between carriers in meters} \times \textit{weight of traction rope per meter})]$$

This is for spiral-construction rope. It works well for the small lines up to about 50 tons hourly capacity. For each additional five tons, 0.05 should be added to the factor 0.85. With locked-coil rope the factor 0.85 becomes 1.05.

The correct laying out of the profile for a ropeway can only be done after much experience; but a few points of importance may be mentioned. Although the rope really hangs in a catenary, it is the usual practice to assume the parabolic formula to obtain the dip of a rope; that is:

$$Dip = \frac{L^2 W}{8 T}$$

where

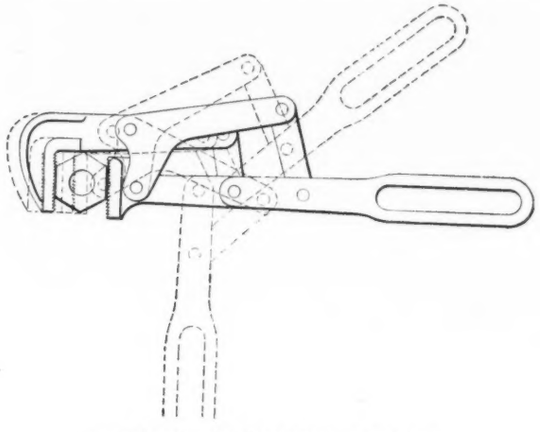
L = Span;
W = Weight per unit length;
8 = The constant;
T = The tension.

When the line is laid out on paper the curve of the rope obtained from this formula is set out and the supporting trestles placed accordingly. It sometimes happens in practice, however, that when the rope is fully tensioned, it floats or rises up from the supporting tower, perhaps because of a small error in the drawn profile. To avoid this, some makers employ a so-called factor of safety for the dip; that is, the denominator $8T$ is multiplied by a constant, the formula giving as a result a dip more than the actual. This factor may be taken at 1.5 for spiral rope and 1.1 for locked-coil rope.

*Abstract from "The Engineer" of July 23, 1915.

Hayward Pipe and Nut Wrench

The Hayward Wrench Co., of St. Louis, Mo., is manufacturing a new pipe and nut wrench, called the "Hayward," in which the wrench opens and closes by a link motion operated entirely by the pull on the wrench



LINK MOTION MONKEY WRENCH

in tightening or loosening the nut. By an ingenious application of this motion the face of the movable jaw remains continually parallel to the face of the fixed jaw. In the illustration the upper dotted line shows the position of the handle when the wrench is fully open, the full lines when it is gripping the nut shown, and the lowest dotted lines, the position when the jaws have met.

Peruvian Mines Employ Nearly 20,000 Men, according to the "Boletin" del Cuerpo de Ingenieros de Minas. Of these, over one-half are employed in the Department of Junin, in which are situated the important operations of the Cerro de Pasco Mining Co. and those of the Backus & Johnson Co.

Details of Milling and Smelting

Recent Progress in Pyrometry

A general review of progress in pyrometry is given by C. R. Darling (*Journ. Royal Soc. Arts*, p. 63, 1915; abstr. *Journ. Soc. Chem. Ind.*, June 15, 1915).

Since 1910 no pyrometers based upon new principles have been introduced, and the advances made have been confined to improvements in methods previously in use. The values now generally recognized for purposes of standardization are—Water, boiling point, 100° C.; aniline, boiling point, 184°; naphthalene, boiling point, 218°; tin, melting point, 232°; cadmium, melting point, 321°; lead, melting point, 327°; zinc, melting point, 419°; sulphur, boiling point, 445°; antimony, melting point, 631°; sodium chloride, melting point, 800°; silver, melting point in reducing atmosphere, 961°; gold, melting point, 1,063°; copper, melting point, graphite covered, 1,083°; lithium metasilicate, melting point, 1,202°; nickel, melting point, 1,450°; palladium, melting point, 1,550°; platinum, melting point, 1,755°; tungsten, melting point, about 3,000°; carbon arc, about 3,500° C.

Thermo-electric Pyrometers—Base metals have been used to a considerable extent for the construction of thermocouples. This has been so not only because of the comparative cheapness of such materials, but the fact that properly chosen base-metal couples develop a relatively high e.m.f. Kowalke has shown that base-metal couples are liable to alter if subjected to continued heating, and suggests that such couples should be "aged" by continued heating before calibration. Carbon and graphite couples have been used for temperatures exceeding 1,200° C. (Bidwell, *Phys. Rev.*, June, 1914). The potentiometer principle has been largely adopted for commercial instruments.

Few changes have been introduced in resistance pyrometers. Sir William Crookes has shown recently that platinum is measurably volatile above 1,000° C., and this explains why pyrometers give erroneous readings when continuously used for higher temperatures.

Charge Car at Midvale, Utah

In connection with the new mechanical-charging system for handling materials from stock bins to furnaces at the plant of the United States Smelting Co., Midvale, Utah, there are used three Brownhoist electric larries of the type shown in Fig. 1. The charge car is mounted on two four-wheel swivel trucks, each having one large pair of wheels and one pair of guide wheels, which permit the larry to be operated on sharp curves. A 19-hp. 500-volt direct-current motor drives the car at full load at a speed of from 600 to 700 ft. per min.

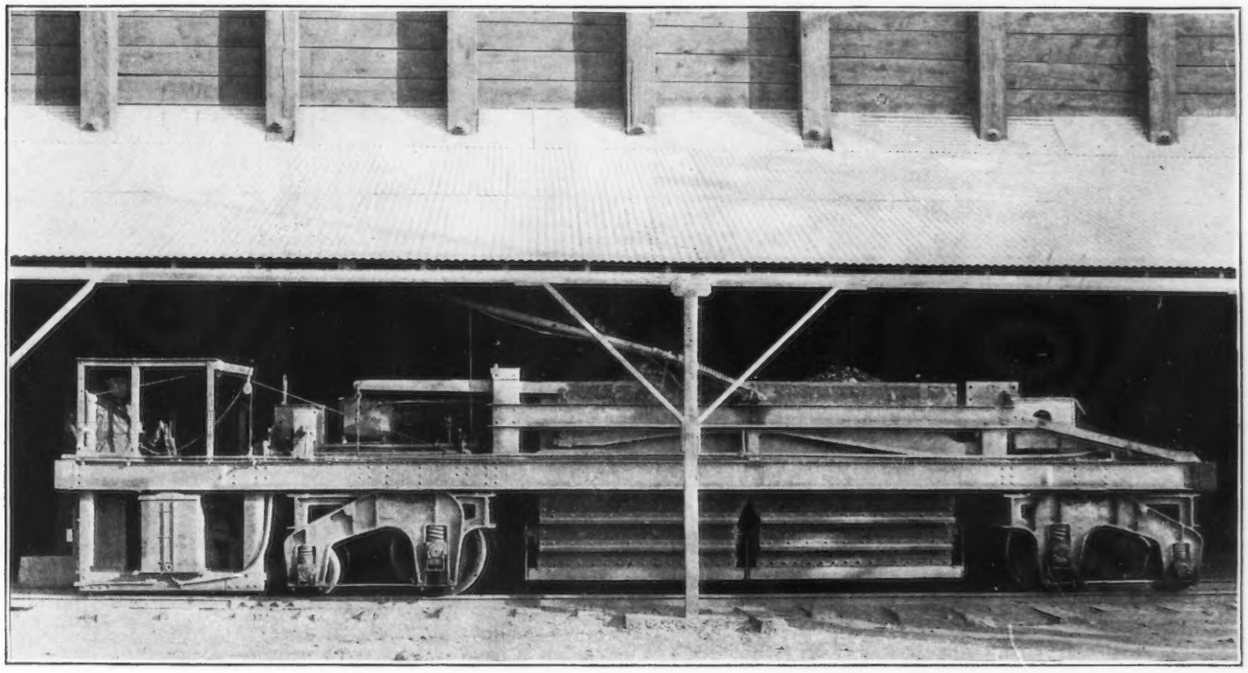


FIG. 1. BROWNHOIST LARRY COLLECTING CHARGE FOR LEAD BLAST FURNACES AT MIDVALE, UTAH

As will be noted in Fig. 2, the operator's platform contains, in addition to the scale beams for weighing the charges, the traveling and bin-gate-operating controllers and the foot brake. The car has a capacity of 120 cu.ft., and the charge is dumped into the furnace through drop-bottom gates. The hopper frame is suspended on scales, so that the weight of each class of material is shown on the scale beam on the operator's platform. The scales have multiple beams, such as are commonly used in mak-

ing up lead-furnace charges. Each beam is set for the exact amount of the certain kind of material wanted, and the operator allows this material to flow into the hopper until the beam balances.

The bins storing bulk materials, such as coke, lime rock, iron ore, roast, etc., are provided with belt gates, shown in Fig. 2. The bedded ores are drawn from the bins by means of the reciprocating arc gates shown in Fig. 3. The bin gates are operated by a 7½-hp. motor on the larry, the connection being made by means of gearing. When the larry, which was built by the Brown Hoisting Machinery Co., of Cleveland, Ohio, is stopped in the proper position beneath the gate, the operator by throwing a lever connects the gate mechanism with a motor on the larry. This operation simultaneously breaks the current through the travel motor, thereby making it impossible to move the car while it is connected to the bin-

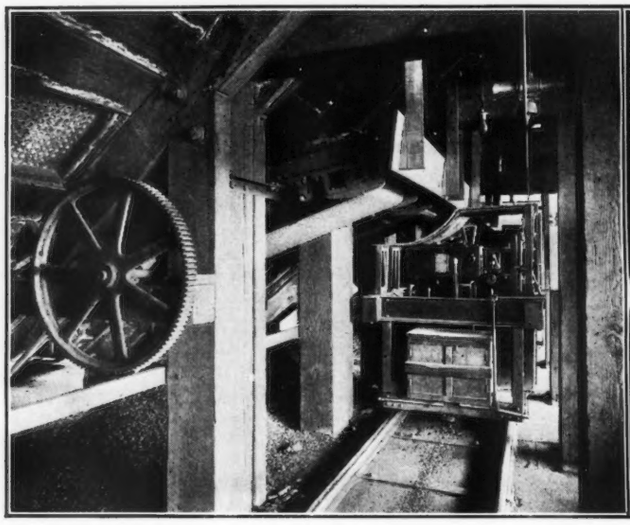


FIG. 2. BELTED BIN GATE OPERATED BY GEARING AND MOTOR ON CHARGING LARRY

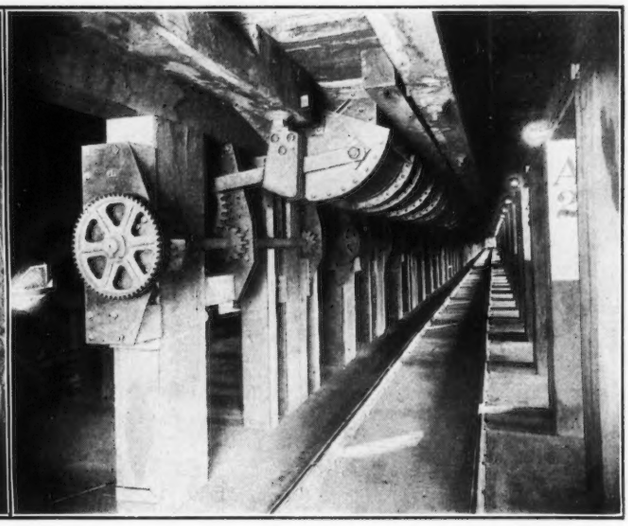


FIG. 3. BEDDED-ORE BINS WITH ARC GATES ALSO OPERATED BY THE CHARGING LARRY

gate gear. A careful operator, with this traveling charge car, is able to make up the charge with the accuracy necessitated by the extreme sensitiveness of the lead blast furnace.

Ore Weighing at the Bunker Hill Mill

At the large concentrating mill of the Bunker Hill & Sullivan Mining and Concentrating Co., at Kellogg, Idaho, a total of about 1,250 tons of ore per day is handled. In consequence of the extreme care which is taken in this mill to secure the highest possible extraction, it is believed that accurate tonnage estimations of the material entering the mill are essential. In order to insure accuracy, a rather elaborate system of weight estimation and checking has been established.

The actual weights are obtained from a Blake-Dennison automatic weigher, which estimates the quantity of material passing over the inclined conveyor belt that delivers ore from the rockhouse into the mill bins. Ore is deposited upon this belt through four Challenge feeders driven by belts, so that the rate of feeding may be made to correspond with conditions.

In order that the weight obtained by the Blake-Dennison machine can be checked from time to time, a fifth Challenge feeder is installed, delivering at a rate equal to the combined rate of the other four. This machine is used only to check weights, and when it is put into use the others are thrown out. A box that holds about 800 lb. of ore is placed on a Fairbanks scale and its contents weighed accurately and then dumped into the Challenge feeder. While this is being fed onto the conveyor belt, the box is filled and weighed again, the contents then being thrown into the feeder. In this way the actual weight of the ore being fed to the belt can be obtained for a measured period and compared with the weight shown by the Blake-Dennison automatic weighing machine during the same time. So long as the automatic weigher checks within 50 lb. in 8,000, in comparison with the hand-weighed parcel of ore, no change is made, but if the error is greater the weighing machine is adjusted to read correctly. This checking is performed at intervals so that no risks will be run of errors in the weight of mill feed. The system is easily managed and insures correct estimation of the amount of ore handled daily by the mill. It is said that the weighing machine does not require frequent adjustment, but maintains its accuracy over long periods of time. The tests are made often to insure safety.

Prevention of Action of Ferric Iron on Copper Cathodes

The re-solution of cathode copper in a cell containing ferric salts is said by Lawrence Addicks to be greatly inhibited by aluminum salts (U. S. pat. 1,138,921). The conditions under which he operates are described as follows: Cu, 3%; ferrous iron, 3%; alumina, 3%; a little free sulphuric acid to prevent the formation of basic salts; current density, 13.5 amp. per sq.ft.; a temperature of 115° F.; and a circulation sufficient to hold the ferric iron at about 0.25%. Under such conditions a 70 to 90% current efficiency can be obtained.

The Assayer and Chemist

Electro-analysis of the Second Group Metals

In a paper read at the New Orleans meeting of the American Chemical Society, E. P. Schoch and Denton J. Brown elaborated on their earlier work on the electro-analysis of the sulphureted-hydrogen group of metals. Their earlier work showed that copper, tin, lead, bismuth and antimony can be determined accurately by electro-deposition out of acidified chloride electrolytes which contain suitable reducing agents such as hydroxylamine or formalin. The present paper asserts that copper, bismuth and antimony can be deposited simultaneously and can be separated from tin and lead; that tin and lead can be deposited simultaneously and separated from cadmium; that copper or bismuth can be separated from antimony by dissolving alloys of these metals in nitric acid plus tartaric acid and electrolyzing the solutions with a limited cathode potential; that bismuth phosphate can be precipitated quantitatively out of the same solution; that tin may be separated completely from lead by dissolving an alloy of these two metals in nitric acid plus potassium nitrate; and that silver in silver chloride may be determined by dissolving the latter in ammonia, adding ammonium nitrate and electrolyzing.

These facts are all combined in the following systematic procedure for the rapid electro-analytical determination of all the common metals the potentials of which are more noble than that of cadmium.

(A) Dissolve sample in hydrochloric acid or in *aqua regia;* an insoluble residue—silver chloride—is dissolved in ammonia plus ammonium nitrate, and the silver determined electrolytically.

(B) Treat solution *A* with hydroxylamine—mercury, gold and platinum will be precipitated.

(C) Out of filtrate *B* remove arsenic by distillation with hydrochloric acid, and determine arsenic iodometrically.

(D) Electrolyze retort residue *C*—copper, antimony and bismuth will be deposited with a cathode potential limited to 0.45 volts (against the normal calomel electrode).

(E) Dissolve metal deposit *D* in nitric acid plus tartaric acid, and precipitate bismuth as bismuth phosphate.

(F) Electrolyze filtrate *E* with a limited cathode potential—copper alone will be deposited. Antimony is obtained by difference.

(G) Electrolyze residue *D* with a cathode potential limited to 0.7 volt against the normal calomel electrode: tin and lead will be deposited. Treat the deposit with nitric acid plus potassium nitrate; the solution contains all the lead and this metal may be deposited as lead peroxide, or the residue of tin oxide may be dissolved in hydrochloric acid plus hydroxylamine and the tin determined by electrolysis.

(H) Electrolyze residue *G* to obtain cadmium or other metals.

Assay of Cyanide Solutions, Lead Acetate Method

Many variations of the lead-acetate method for assaying cyanide solutions have been devised and published, most of them differing only in details. While all these methods will give good results, the majority of them require so many steps and so much time that it is apparent that they have never been tried out under practical working conditions in a busy laboratory, or that the writers intended them to be used only in experimental work where the chemist could devote his entire attention to a few solution assays.

The method described here was devised to meet the requirements of a laboratory where the assayer is called upon to run 10 to 20 solution assays daily in addition to 50 to 70 fire assays and perhaps a few leads, coppers, zincs, etc., and has no time to manufacture lead cones, wash the sponges numerous times, filter, scorify and what not, yet must obtain accurate results. No claim is made for any improvement in the chemistry of the assay. The advantage of the method lies in the speed with which a number of determinations can be made, due to the mechanical manipulations that will be described in detail. Briefly the assay consists of the following steps: Measuring out 10 a.t. solution, adding 30 c.c. lead acetate solution and 1½ to 2 grams zinc dust, heating, adding 50 c.c. hydrochloric acid, boiling, removing and squeezing the sponge, drying the sponge and cupelling.

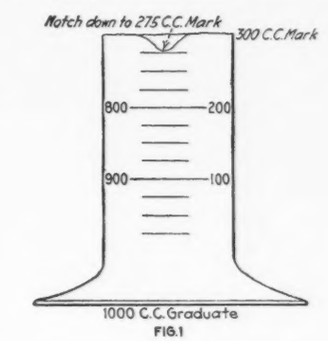


FIG. 1

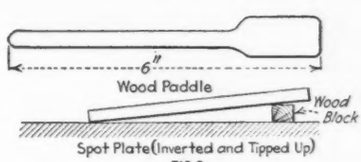


FIG. 2

APPARATUS FOR SOLUTION ASSAYING

The 10-a.t. charge is measured in the graduate shown in Fig. 1. A 1000-c.c. graduate is cut off at the 300 c.c. mark and a notch broken out of the rim down to the 275-c.c. mark, or thereabouts. The exact size of this opening can only be determined by trial and should be such that when the graduate is rapidly filled to the top the excess solution will flow out through the notch down to the 292-c.c. mark, surface tension holding the liquid above the bottom of the notch. The advantage of this graduate in saving time is apparent, no careful filling and pouring out to a certain mark being necessary. The solution is added rapidly and the excess drains off immediately, leaving exactly the right amount.

Solutions are usually brought to the assay office in beer bottles or the like. Time can be saved in pouring by

grasping the bottle with the hand inverted, turning the bottle over and at the same time giving it a quick rotating motion. The solution will then run out whirling, as water does down a drain, rapidly and with no gurgling.

The beakers are now placed on a hot plate. A beaker of 600-c.c. capacity, tall shape, is most convenient for a 10-a.t. charge, as it takes up less room on the hot plate, and the extra volume prevents the charge from boiling over when the acid is added. Lead-acetate solution 30 c.c. and 1½ to 2 grams of zinc dust are now added. A 250-c.c. graduate cut off at the 100-c.c. mark from the bottom is most convenient for measuring the acetate solution and hydrochloric acid. A quantity of the zinc dust may be kept in a pan or dish and dipped out with a spatula. After a trial or two the exact amount can be estimated. The addition of these two reagents takes but a minute for a number of assays. The acetate solution must be saturated. In order that a sufficient quantity of the solution be always on hand, two or more bottles should be prepared, the supernatant liquid from the oldest bottle being decanted when needed, and after the determinations are made all the bottles should be violently shaken to insure further solution of lead acetate. The bottles will then clear by the next day. When one bottle is empty it should be refilled and the next bottle in order used. As soon as the solutions on the hot plate come nearly to the boiling point, 50 c.c. HCl is added to each, and the solutions boiled until perfectly clear. The hotter the plate the quicker the solutions will clear, within reasonable limits of course. The sponge formed will cling together if the lead-acetate solution used was clear, and will usually float. This can be easily removed from the liquid by means of a 6-in. wood paddle, shown in Fig. 2, placed on an inverted spot plate and by a few squeezes between two paddles shaped into a cube, with nearly all moisture removed. If the spot plate is tipped up at a slight angle by means of a block of wood, as shown in Fig. 2, the liquid will flow off as it is squeezed out of the sponge.

The cubes of lead sponge are next placed upon the hot plate and thoroughly dried; the plate, however, must not be so hot as to cause lead globules to melt out of the sponges. After drying, which takes but a few minutes, each sponge is wrapped in a piece of lead foil about 1½ in. square and is then ready for cupelling.

It will be observed that the time required for measuring the solutions, adding reagents and preparing sponges for cupelling is reduced to a minimum. While the solutions are boiling the assayer can be busy with other duties, getting the sponges ready for cupelling when all the other cupelling is done. Hence a number of solution assays can be run with little expenditure of time and with little attention. The results too are all that can be desired of the average solution assay. Even traces of metals are easily saved, and the duplicates check remarkably well.

Cupellation Losses

According to a recent investigation by W. J. Sharwood (*Trans.* A. I. M. E., August, 1915), cupellation losses on silver or gold buttons of different weights, run under identical conditions, closely follow this rule:

$$y_1 \ (weight\ lost) = cx^{\frac{3}{2}}$$

$$y_2 \ (percentage\ lost) = cx^{-\frac{1}{2}}$$

where c is a constant to be determined by running a proof and x is the weight of the button. The bearing of this is: If c be determined by a proof, in a muffle where there are buttons of varying weights, then a correction can be calculated for all the various-sized buttons from the one known case.

Making Up Standard Permanganate Solution*

It is well known that a $KMnO_4$ solution freshly made with the usual distilled water of an industrial laboratory precipitates MnO_2, thus changing its strength. Instead of endeavoring to prevent this I help it along as nearly to completion as possible and find our finished solution does not change more than the contraction and the expansion due to changes of temperature alter it.

The procedure is as follows: Weigh out the amount of $KMnO_4$ necessary to make the solution somewhat weaker than the desired strength (enough weaker more than to compensate for some incidental evaporation later on). Put the solution into a number of large flasks and place them on the steam plate. Make another solution in the same way, but much stronger and much less in volume; place this also on the steam plate and keep both near the boiling point for some time—two days if possible.

The reactions that precipitate MnO_2 will be practically completed, and no water may thereafter be added to either solution. Filter both solutions separately through filters made of prepared asbestos spread over broken glass in a large funnel or percolator. Then determine their strength precisely and measure the weaker solution carefully.

Add to the weaker solution a sufficient amount of the stronger to bring the strength up to the desired factor. This amount is determined by the following formula:

$$n = \frac{m\,(a - c)}{c - b}$$

in which

m = Number of cubic centimeters of the weaker solution;
a = Factor of the weaker solution;
n = Number of cubic centimeters of the stronger solution required;
b = Factor of the stronger solution;
c = Factor of the desired solution.

By substitution n is obtained. Add this amount of the stronger solution to the weaker and mix thoroughly. Determine the strength of the resulting solution. A correction is seldom necessary. Its factor is exactly what is wanted and its variation practically negligible.

I have always kept my $KMnO_4$ solution in a carboy painted black. I do this by tradition, but as to whether it is really necessary I have some doubt. A carboy of $KMnO_4$ solution lasts about a year, and one carboy showed the following variation in its iron factor as shown by testing with sodium oxalate furnished by the United States Bureau of Standards: 9-17-13 = 0.002807; 10-27-13 = 0.002808; 4-4-14 = 0.002800; 4-22-14 = 0.002790.

The method is widely applicable. It can be used to advantage in making standard alkali solutions for phosphorus determinations in iron and steel. In this the carbonic acid may be precipitated with excess Ba $(OH)_2$ and the supernatant solutions used.

*From an article by H. E. Moyer in the "Chemist-Analyst."

Refining Cyanide Precipitates

By H. T. Durant*

SYNOPSIS—Ordinary methods of acid treatment of cyanide precipitates fall short of the desired results because all the impurities are not removed. The methods pointed out in this article enable the practically complete removal of foreign substances and the production of high-grade bullion.

The mixed product that results from the usual clean-up in cyanide plants consists, before any acid treatment and apart from gold and silver contents, of two classes of constituents. The first class includes those substances which are, or could be, rendered soluble with the aid of sulphuric acid, though not necessarily under the conditions which are possible at cyanide plants; and the second class includes those substances which could not be rendered soluble by these same means.

Separation of impurities

The group of substances that are soluble in sulphuric acid consists principally of zinc metal and compounds, copper metal and compounds, and iron and its compounds. There are, besides, various complex cyanides, ferrocyanides, and other elements which occasionally exist in various combinations and quantities, such as magnesium, aluminum, nickel and tellurium.

The group of substances insoluble in sulphuric acid consists principally of sand, calcium carbonate, calcium sulphate, lead and its compounds, and carbonaceous matter. Of these substances sand is usually present as a result of defective filters or of atmospheric dust. Both of these causes can be guarded against and therefore the amount of sand present can be kept down. Calcium compounds cannot always be so easily kept low. Lead, apart from being a more or less regular constituent of zinc, has often to be used to aid the precipitation work. Carbonaceous matter is also present in zinc to a slight extent. It is evident that if everything which is theoretically soluble in sulphuric acid were actually so, there would remain for smelting very small quantities of impurities after acid treatment. The general analysis of the slimes before and after acid treatment, and also after the drying or calcining that follows the acid treatment, is pretty well known to operators.

Usual Acid Treatment Incomplete

As a rule there remains after acid treatment a large proportion of substances belonging to the first class. This is evident from the base metals in the bullion produced, also from a rough, pocket-lens examination of the slimes after acid treatment and calcination.

The fact that certain complex cyanides are not affected by the acid treatment is shown by the ammonia given off during the subsequent calcination. It is easily seen by a small-scale experiment that material which has been acid treated and calcined will usually, by further acid treatment, yield in a soluble condition more of the substances of the first class. This further acid treatment has of course been rendered effective by the calcination (oxidation) which has converted sulphides into sulphates or oxides, and insoluble cyanides into soluble compounds. Beyond this, any metallic zinc that during the first acid treatment might have been protected by lead or copper or the sulphides of these metals, will be oxidized during calcination or otherwise prepared for further acid treatment.

The ordinary acid treatment is generally carried out in a lead-lined tank fitted with a water-seal cover, gas-escape pipe, steam-heat attachment and mechanical agitator, or in some apparatus that answers the same purpose. In any case the efficient agitation is most important, as all the material that is to be acid treated should be kept well in motion.

As this acid treatment proceeds the increasing amount of fine slimy material formed will tend more and more to protect material from the action of the acid, and therefore efficient agitation, even to the point of attrition, becomes more and more important. When the ordinary acid treatment has been finished so that practically no further action takes place and the slimes are still in the acid-treatment tank, any substances of the first class which remain can be removed by the procedure that I shall outline; and any lead or lead compound that may also be present can be turned into sulphate so that it will not appear in the final bullion bar.

Removal of Residual Impurities

First of all decant or filter off as much as possible of the well-settled zinc solution, leaving all the slimes in the acid-treatment tank; then run in fresh water till the total weight of water is about five times the assumed dry weight of the slimes in the tank. While continuously and thoroughly agitating, add separately strong sulphuric acid (whatever strength is available) and then bichromate of potassium previously dissolved in as little hot water as possible. It is better while this treatment is going on to keep the contents of the tank heated. These two chemicals are always required in the proportion of 2½ lb. of actual sulphuric acid (or say 4 lb. of 66% acid) to each pound of solid bichromate of potassium. The actual total amount of acid and bichromate to be used will naturally depend on the quality of the slimes in the tank; but each addition of say 10 lb. of sulphuric acid (or 16 lb. of 66% acid) will be followed by 4 lb. of bichromate of potassium dissolved in as little hot water as possible.

Three or four minutes after adding the bichromate a small sample of filtered solution from the tank can be tested for chromic acid by well-known tests or it may be evident from the color of the filtered solution. When chromic acid is present and persists for a minute or two the acid treatment is finished, but until this persistence of chromic acid in the solution is obtained it is necessary to continue the addition of sulphuric acid and bichromate as described. When treatment is finally finished, the slimes, after very thorough water washing, are collected and dried in the usual way and are then ready for smelting.

It has been found that a small-scale trial in a glass flask will show in a few minutes the alteration, if any, when the treatment with acid and bichromate follows the ordinary acid treatment. This treatment with acid and

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bichromate should not be carried out until the ordinary acid treatment has been worked to a finish, as previously described. Salt or hydrochloric acid should not be used either in the ordinary acid treatment or in the subsequent acid and bichromate treatment. After treatment with acid and bichromate the slimes will settle well without any of the usual aids, such as glue and alum.

Some Alternative Practices

Instead of bichromate of potassium there could be used the same weight of bichromate of sodium. Similarly, permanganate of potassium or sodium in calculated equivalent quantity could be used, but it is not so satisfactory for several reasons. If the treatment with acid and bichromate is carried too far the only trouble is that silver will begin to be dissolved, although this can be recovered from the solutions if necessary. The finished slimes are heavy and after slight heating, in order to dry them thoroughly, will generally appear as annealed gold, and sometimes will show the gold color even before heating.

Unless much sand is present no flux other than borax glass is required; it is well, however, always to add a little niter to oxidize any small amounts of carbonaceous matter that may be present. The finished slimes must be smelted in a clay crucible. They must not be put in a plumbago crucible and should not be in contact by stirring or otherwise with plumbago or any reducing agent during or before smelting; otherwise a mixed lead matte may be formed. The final bullion should be practically free from zinc, lead and copper. The extra cost for acid, bichromate and labor in this work will be more than compensated for by the decreased cost of fluxes in the smelting; by the fact that no light, dusty slimes will be handled; by the saving of time, labor, and fuel in the smelting; and by decrease in the amount of slag produced. Practically all the bullion will be obtained at once in the bars.

Nevada-Douglas Mill Running

The furnace for the manufacture of nitric acid at the leaching plant of the Nevada-Douglas mill at Ludwig, Nev., started Aug. 30 and the crushing of ore in the new mill at Ludwig commenced Sept. 2, according to the Yerington *Times*. The mill is about completed, though the furnaces and driers are not yet fully installed and some additional tanks will be built. A force of 10 masons is rushing to completion the Wedge furnace, which will treat 250 tons of ore per day. The oxidized-ore yard, which will accommodate 2,500 tons, is also built and ready for receiving the ores now passing through the crushers.

The repair work at the mines is all done, and as soon as the mill and furnaces are completed a force of probably 100 men will be put to work in the mine, largely increasing the number now employed. There are about 100 men on the leaching plant finishing the mill, tanks and furnaces and installing the remaining machinery. At first it is expected to treat from 200 to 300 tons per day, and then as soon as the present plant is finished to increase the tonnage to 500 tons per day. As the mill capacity can be run up to 750 tons per day the leaching capacity will be increased by adding another unit to meet the requirements of the mill.

Australian Zinc Contracts

During the week of Sept. 4, the Zinc Corporation made a further attempt in the High Court to obtain a decision on the effect of the war upon its contract with Aron Hirsch & Sohn, of Halberstadt, Germany, says the *Mining Journal* of London.

It will be remembered that on a previous occasion the plaintiffs were nonsuited, but since that date legislation has been passed providing for the representation of enemy parties in a suit. The facts of the case are, shortly, that the Zinc Corporation, by an agreement dated Sept. 14, 1908, agreed to deliver 355,000 to 385,000 tons of zinc concentrates in certain quantities from their works at Broken Hill to the defendants. At the time the contract was entered into the company was registered in Victoria, but in July, 1911, it was incorporated in England. The Australian Government has, since the war, by the Enemy Contracts Annulment Bill, terminated these contracts. The English Government, however, has up to the present taken no such step, and on the result of the action now proceeding, in which a decision will no doubt be sought in the House of Lords, eventual action by the British Government will probably depend.

The most material clause in the contract, numbered 17, provided as follows: "In the event of any strike, lockout, combination of workmen, interference of trade unions, suspension of labor, whether partial, local, or general, and from whatsoever cause arising, floods, storms, fire, stoppage of water supply, washaways of railways, accidents, acts of God, force majeure or perils of the sea, breakdown of machinery, or inability of the Silverton Tramway Co. to provide the necessary trucks for taking away the concentrates, or in the event of any cause beyond the control of either the sellers or the buyers preventing or delaying the carrying out of this agreement, then this agreement shall be suspended during the continuance of any and every such disability."

Mr. Gore-Browne, K. C., on behalf of the company, argued that the agreements had not been merely suspended in the terms of this clause, but had been entirely abrogated as involving commercial intercourse with the enemy. Such intercourse, where one of the parties was an alien enemy, was prohibited as illegal. Therefore the contract under which those transactions took place was itself rendered illegal and void. It would be an utterly unreasonable view for the court to take that the plaintiffs must sit down and wait for the end of the war for the rights under the contract to revive. Suppose Germany carried on the war for 20 years, and history repeated the Napoleonic wars, were all these transactions to be open to enforcement then? A contract which tended to the advantage of the enemy country or was prejudicial to the interests of this country was prohibited. The contract here was detrimental to the interests of this country, because it altogether prevented the plaintiffs from selling zinc concentrates during the period of the war. It was important that this country should have a large supply of spelter for the manufacture of munitions of war. If the contract was merely suspended during the war it would be impossible for the plaintiffs to sell their zinc concentrates to persons other than the defendants, because no one would expend large sums in the erection of refining works unless it was certain that the supply of zinc concentrates would be continued after the war.

It was clear, on looking at the details of the agreement, that it was not intended that the whole of the agreement should be suspended under clause 17, but only the making and taking of deliveries should be suspended, and therefore as something had to be done under the contract during the war which involved commercial intercourse with the enemy the contract was dissolved. Further, war was not one of the causes within clause 17 which gave the right to suspend the contract. Force majeure meant something of a physical nature which prevented the contract from being carried out, and it did not include war. The words "any cause beyond the control of either the seller or the buyer preventing or delaying the carrying out of this agreement" must be construed as ejusdem generis with the causes previously mentioned, and did not include war, which was a totally different cause. He submitted that the contract came to an end, vested rights under the contract alone being enforceable after that date.

On behalf of the defendants, Mr. Compston, K. C., submitted that the outbreak of war was an event which was not so different from the events mentioned in the clause as suspending the fulfillment by either side of contractural obligations that it could not apply to this case. During the war there was necessarily a suspension of some of these obligations, but it was not contrary to public policy for a contract made before the war to provide that after the war trading

should be resumed with persons who in the interval had become alien enemies. The defendants denied that the zinc concentrates purchased in Australia were imported into Germany to be there smelted. They were imported to and smelted in England, France, and Belgium, and only a small proportion went to Germany. All past consignments were not freed from the conditions of the contract, and although payment could not be demanded until there had been an adjustment of the invoices such an adjustment did not involve prohibited commercial intercourse between the seller and the purchaser.

On Sept. 7 decision was delivered against Aron Hirsch & Sohn by Mr. Justice Bray, according to the London *Financial News,* which says:

Giving judgment, his Lordship said that when war broke out the defendants, to whom the whole of the plaintiffs' output of spelter was to be sold, according to the agreement, became alien enemies, and they at once told the plaintiffs that they would discontinue the acceptance of any more spelter until the end of the war. The Zinc Corporation now contended that the outbreak of hostilities rendered the performance of the contract by them illegal, and the defendants, on the other hand, submitted that the delivery of the spelter was merely suspended until the war was over.

His Lordship said the questions were: Was war to be one of the causes of the suspension of the contract, and what was the meaning of the words "shall be suspended"? The court could not substitute for an agreement made between the parties another agreement minus one of its terms. The difficulty was that an event had arisen which was not contemplated when the agreement was entered into, and, after having given careful consideration to the clauses and all the circumstances of the case, he had come to the conclusion that the contract should be declared to be dissolved as from Aug. 4, 1914, when war broke out. Plaintiffs would be absolved from the obligation to supply the goods to defendants without prejudice to the defendants' rights to take proceedings for alleged breach of contract by the plaintiffs before that date.

Judgment was entered accordingly for the plaintiffs with costs. The defendants intimated that they would appeal.

Shortage of Metals in Austria

According to a Reuter dispatch from Zurich, dated Sept. 5, a highly significant admission of the growing shortage of war metals in Austria is contained in a semi-official communiqué from the Central Metals Organization, which was established jointly by the Government and the Ministry of War for the purpose of obtaining metals for the manufacture of munitions. The communiqué frankly states that hitherto the Organization has never appealed to the public because it has been obtaining all necessary supplies from wholesale quarters, but that since the latter are now exhausted it is forced to invite the public to sell voluntarily their metal goods rather than force the authorities to requisition them. All owners of articles composed of pure nickel, copper, brass, and bronze are directed to sell them forthwith to the Metals Organization. This applies to merchants and dealers as well as private persons.

This seems to lend color to the Italian charge that the great bronze statue of Dante at Trent has been broken up and remelted.

Asphalt in Honduras

Asphalt has been found in Honduras, according to a report from Special Agent G. Harris to the Department of Commerce. The discovery is on the west coast, in the vicinity of Juticalpa. Prospects uncovered for over 450 ft. show the bed to be of great purity, and there are outcroppings for several miles. The discovery was made by an American citizen resident in Honduras, who has the control of the property. It is considerably distant from the Pacific port of Amapala, which will have to be the port of shipment, but is on the line of a new model road the Government of Honduras is preparing to construct, so that motor transportation will soon be available; and it is not greatly distant from the logical line of the contemplated railroad from Amapala to the interior.

Clifton-Morenci Strike

More than 8,000 miners, about one-half of them Mexicans, are on a strike in the Clifton-Morenci district for higher wages. The strike, which became general Sept. 12, has tied up the mines of the district, and serious trouble is threatened by the Mexican element involved in the strike.

The Mexican miners were receiving from $3 to $3.50 a day, and the more skilled American miners received wages running to $5 a day. The companies refuse to grant the demand for more pay.

Agitators of the Western Federation of Miners have been in the district for weeks stirring up the men, and it is said Mexican agitators have also been appealing to the prejudices of the Mexican miners.

The *Boston News Bureau* prints the following under date of Sept. 21:

"Entire plants of the Arizona, Detroit and Shannon copper companies in Clifton, Morenci and Metcalf have been formally turned over to Sheriff Cash of Greenlee County for protection.

"Sixty-five to seventy deputies are posted to guard the mines and smelteries, which are also heavily picketed by strikers. No attempt will be made to operate. At mass meeting strikers ratified committee of nine named to treat with companies. Two representatives of the companies were present at meeting. Companies posted notices they were willing to treat with the men, but could not recognize Western Federation miners. Situation quiet and no trouble is anticipated. Strikers are confident of victory and companies are equally determined."

Ontario Mineral Production in First Half of 1915

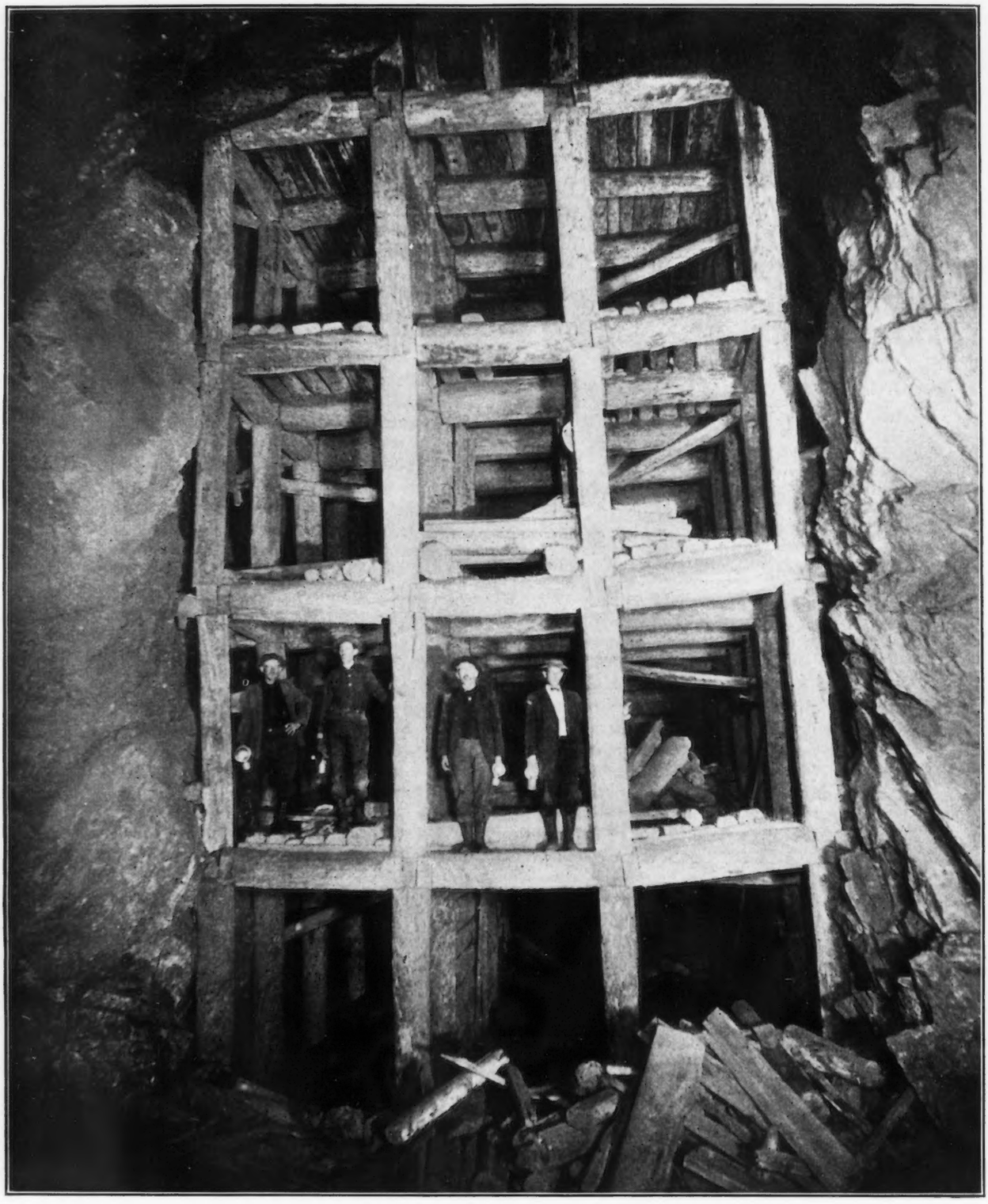
The Bureau of Mines report for the first six months of 1915 states that the output of gold for Ontario during that period was $3,570,072, as compared with $2,011,069 for the corresponding period of the previous year. Of the total yield for the period under review $2,267,620 came from Porcupine. Promising developments are in progress in other fields, particularly in the Kirkland Lake district. The Goodfish Lake section is also being developed, and ore of remarkable richness is being taken from the Dobie mine in Monroe township.

The diminution in the output of silver continues, the value of the output for the period being $5,188,763, as compared with $7,053,418 for the same period in 1914. The falling off in value is partly due to the lower prices being obtained for silver, but is also largely due to the exhaustion of the high-grade ore from the mines.

The output of nickel is the highest ever recorded, but on the basis of present production the amount will be considerably exceeded in the second six months of 1915.

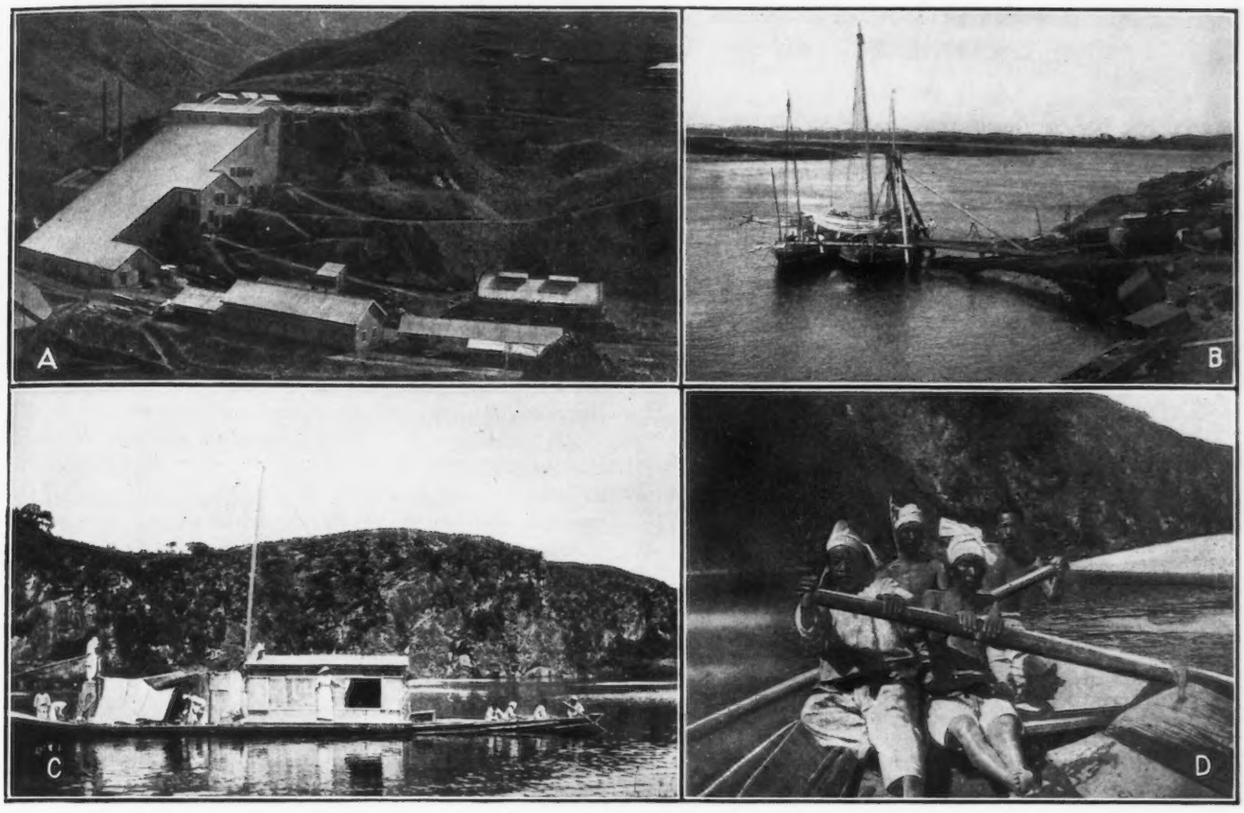
The production of copper, iron ore and cobalt showed slight increases, while pig iron and cobalt-nickel oxides showed a decline.

Photographs from the Field



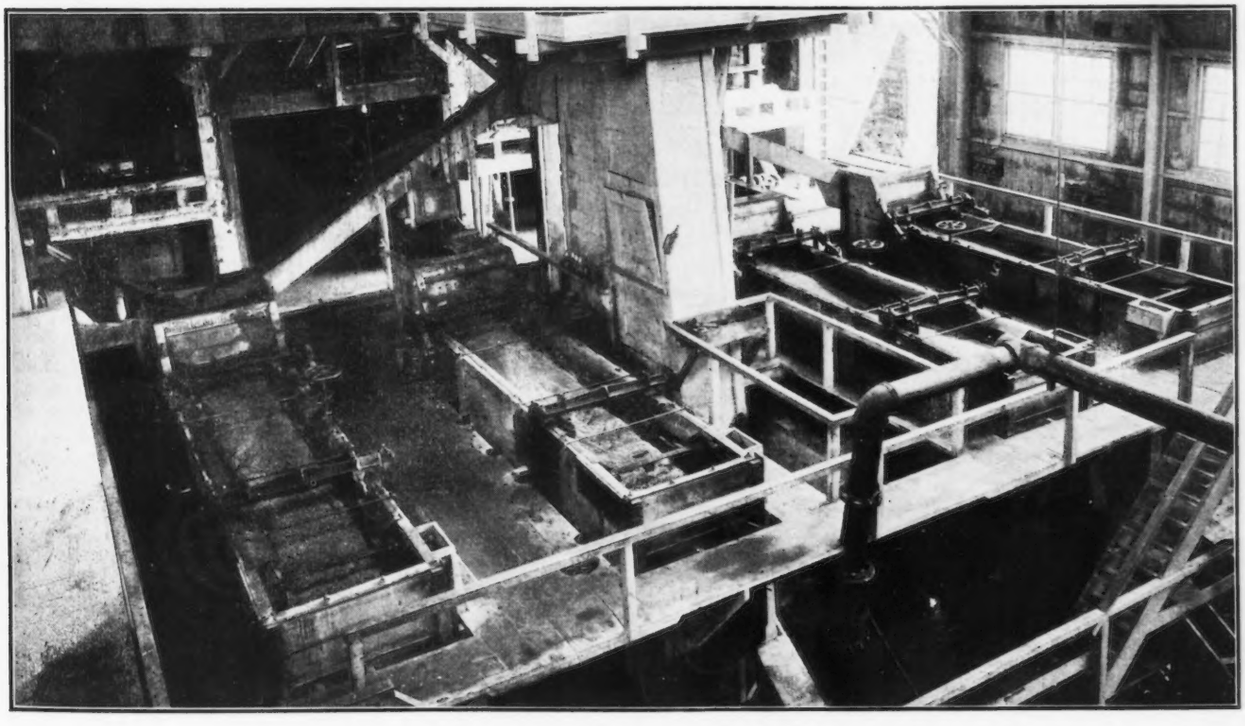
STOPE IN THE HOMESTAKE MINE, LEAD, S. D.

This photograph shows the great size of the stope, together with the system of timbering used in such cases



OPERATIONS OF THE SEOUL MINING CO., HOLKOL, CHOSEN

A—Suan 200-ton mill. B—Unloading heavy machinery at main electric station. C—Houseboat used in traveling on Tai Dong River. D—Motive power of the native freight boats



JIGS AT THE WASHOE CONCENTRATOR

Hancock jigs in the remodeled section, No. 1, of the Washoe concentrator at Anaconda, Mont., of the Anaconda Copper Mining Co.

Precious-Metal Production in the United States

A memorandum of the revised statement of gold and silver production in the United States in 1914 was given in the *Journal* of Sept. 4. The full statement of production by states as apportioned by the Director of the Mint and the Geological Survey is shown in the table herewith. The figures for gold are the value; for silver the quantity in fine ounces.

	Gold: Value		Silver: Fine Oz.	
	1913	1914	1913	1914
Alabama	$9,200	$12,300	100	300
Alaska	15,201,300	16,547,200	366,700	865,900
Arizona	4,104,400	4,568,900	3,912,000	4,439,500
California	20,241,300	21,251,900	1,421,500	2,020,800
Colorado	18,109,700	19,902,400	8,989,700	8,804,400
Georgia	13,300	16,800	100	100
Idaho	1,244,300	1,187,200	9,477,100	12,573,800
Illinois	.....	.....	2,300	1,900
Maryland	700	200	.....	100
Michigan	.....	.....	333,700	415,500
Missouri	.....	.....	38,900	60,000
Montana	3,320,900	4,143,600	12,540,300	12,536,700
Nevada	11,977,400	11,536,200	15,657,400	15,877,200
New Mexico	892,000	1,219,100	1,666,900	1,771,300
North Carolina	115,200	130,300	1,700	1,500
Oklahoma	.....	.....	800	6,200
Oregon	1,477,900	1,589,400	172,200	147,400
South Carolina	4,100	3,200	.....	.....
South Dakota	7,214,200	7,334,000	172,600	179,800
Tennessee	7,700	6,400	109,000	102,800
Texas	200	8,800	429,800	574,700
Utah	3,570,300	3,377,000	11,282,300	11,722,000
Virginia	.....	300	200	1,500
Washington	657,500	587,800	218,700	341,300
Wyoming	17,500	6,700	1,200	100
Continental United States	$88,176,100	$93,429,700	$66,796,200	$72,444,800
Porto Rico	1,100	2,800	.....	.....
Philippines	707,200	1,099,300	5,300	10,300
Totals	$88,884,400	$94,531,800	$66,801,500	$72,455,100

California was the leading gold producer in 1914, Colorado second, Alaska third and Nevada fourth. A second group of large producers included South Dakota, Arizona, Montana and Utah. The eight states named produced 93.8% of all the gold won in the United States.

In 1914 Nevada was the chief silver producer, Idaho being second, Montana third and Utah fourth. A second group included Colorado, Arizona, California and New Mexico. None of the other states produced as much as a million ounces of silver.

Michigan Iron Lands at Auction

SPECIAL CORRESPONDENCE

The holdings of the Pittsburgh & Lake Angeline Iron Co. were sold at public auction at Ishpeming, Mich., on Sept. 15. The Cleveland-Cliffs Iron Co. bid in the Lake Angeline mine for $27,000. Only other bidder was the Jones & Laughlin Ore Co., which bid $26,500. This is believed to be a remarkably low price for the mine, buildings, machinery and 60 dwelling-houses. The tract comprises 200 acres. The Mitchell property, three miles south of Ishpeming, sold for $2,000. Other small tracts, none of which contain mineral, were sold for low prices. The entire holdings did not bring $35,000. The Cleveland-Cliffs Iron Co. has not decided what will be done with Lake Angeline, but it is believed that the little ore in sight will be mined, and exploratory work carried on. The property lies between the Lake and Salisbury mines of Cleveland-Cliffs, and it is believed that chances of locating other high-grade leases are good. The land contains about 2,000,000 tons of low-grade ore, which is not in demand at this time. The Mitchell also has considerable low-grade ore, with some better grades at depth. The Mitchell stopped working several years ago when the Oliver Iron Mining Co. closed its Sect. 21 mine. The Oliver company was pumping the Mitchell water at that time, and the Lake Angeline company did not care to go ahead and install pumps and take care of the heavy flow.

American Institute of Mining Engineers, San Francisco

EDITORIAL CORRESPONDENCE

The American Institute of Mining Engineers began the 111th meeting in San Francisco on Sept. 16 at the Bellevue Hotel. The meeting was opened by C. W. Merrill presiding, and an address of welcome on behalf of California was delivered by Gov. Hiram Johnson. President Saunders replied to the Governor's welcome on behalf of the Institute, and the technical work of the sessions was begun by the presentation of a paper on "Underground Mining Systems of Ray Consolidated Copper Co.," by Lester A. Blackner. This was followed by a paper on "Some Problems in Copper Leaching," by L. D. Ricketts; "Notes on Homestake Metallurgy," by Allan J. Clark; and the "Metallurgy of Gold in the Witwatersrand District, South Africa," By F. L. Bosqui.

The afternoon was occupied by two sessions in separate apartments. The Gold and Silver session was presided over by F. Lynwood Garrison. The following papers were presented: "Mill and Cyanide Plant of Chiksan Mines, Korea," Charles W. DeWitt; "Electric Furnace for Gold Refining at the Alaska-Treadwell Cyanide Plant," W. P. Lass; "Cyaniding Practice of Churchill Mining Co., Wonder, Nev.," E. E. Carpenter; "Zinc-Dust Precipitation Tests," Nathaniel Herz; "Recovery of Mercury from Amalgamation Tailings, Buffalo Mines, Cobalt," E. B. Thornhill; "Slime Agitation and Solution Replacement Methods, West End Mill, Tonopah, Nev.," Jay A. Carpenter; "Amalgamation Tests," W. J. Sharwood; "A Rule Governing Cupellation Losses," W. J. Sharwood; "Tonopah Plant of the Belmont Milling Co.," A. H. Jones. The session on Geology and Mineralogy was presided over by James F. Kemp. The following papers were presented: "Geology of the Iron-Ore Deposits In and Near Daiquiri, Cuba," James F. Kemp; "Formation and Distribution of Residual Iron Ores," C. L. Dake; "Occurrence of Covellite at Butte, Mont.," A. Perry Thompson; "Formation and Distribution of Bog Iron Ores," C. L. Dake; "Geology of the Burro Mountains Copper District, New Mexico," R. E. Somers; "Additional Data on Origin of Lateritic Iron Ores of Eastern Cuba," C. K. Leith and W. J. Mead; "Method of Making Mineralogical Analysis of Sand," C. W. Tomlinson; "Formation of the Oxidized Ores of Zinc from the Sulphides," Y. T. Wang; "Copper Deposits of San Cristobal, Santo Domingo," Thomas F. Donnelly.

For the remaining period of the convention the technical program provides for a session on electrometallurgy, in conjunction with the American Electro-Chemical Society, to be presided over by Lawrence W. Addicks, president of the latter society; a session on Petroleum and Gas, Arthur F. L. Bell presiding; a session on Mining, Milling and Non-ferrous Metallurgy, Karl Eilers presiding; a session on Iron and Steel, Joseph W. Richards presiding.

The Panama-Pacific Exposition management provides for an American Institute of Mining Engineers Day at the Court of Abundance. Other social entertainments and technical excursions are provided for by the International Engineering Congress. The technical excursions include visits to fire systems, gasworks, water-works, delta lines and power plants in and around San Francisco. The distant technical excursions include the deep gold mines at Nevada City and Grass Valley, the hydro-electric development at Blue Lakes, the gold-dredging fields at Oroville, the hydro-electric development at Las Plumas and the oil fields at Coalinga. The pleasure trips began with an automobile ride for the ladies attending the Institute on Thursday, which included a visit to the Cliff House and the exposition. Other visits will include a trip to Mt. Tamalpais, a lawn party at the University of California, another automobile trip for the ladies, a banquet at the Palace Hotel and a cruise and inspection trip of the harbor of San Francisco. Besides the program by the International Engineering Congress, D. C. Jackling has placed at the disposal of members of the Institute and ladies his private yacht "Cyprus." The cruise will extend to points of interest on San Francisco Bay and possibly through the Golden Gate.

California Metal Output, 1914

The total yield of mine gold in California in 1914, as reported by the United States Geological Survey, was $20,653,496, an increase of $246,338 over that of 1913. With the exception of one year (1883) the mine-gold output of the state in 1914 was higher than at any other time since 1864, fifty years ago.

In 1914 there were 658 properties reporting production, of which 318 were deep mines and 340, placers. The producing deep mines may be classified by metal product as follows: Gold, 277; copper, 19; silver, 7; silver-lead, 6; and lead, 9. Of the placer mines 105 were hydraulic, 60 dredges, 70 drift, and 105 sluicing or surface-placer mines.

The 318 deep mines made an output of 2,465,485 tons of ore, of which 2,050,377 tons were siliceous precious-metal ore, 397,868 tons copper ore, 640 tons lead, 460 tons silver, and 16,180 tons silver-lead ore.

In 1914 there were treated in gold and silver mills in California 1,993,821 tons of ore, containing altogether $10,743,207 in gold, an average value of $5.39 per ton, and $91,327 in silver, an average value of $0.05 per ton. This gives a total value of $10,834,534 in gold and silver, or an average per ton of $5.44 in both metals. In milling the 1,993,821 tons of ore there was recovered as bullion $8,637,329 in gold and silver, or $4.33 per ton; and from this ore was derived 46,072 tons of concentrates, which yielded in gold and silver $2,197,205, or an average of $47.69 per ton.

The 449,132 tons of smelting ore treated yielded altogether metals valued at $5,633,856, or an average of $12.54 per ton, including all metals. There were treated also 22,532 tons of old tailings, which yielded $83,624 in gold and silver, or an average of $3.71 per ton.

The 340 productive placers in California yielded $9,080,849 in gold and $19,287 in silver, a total of $9,100,136, which is an increase of $242,590 from this source over the yield of 1913. The dredge yield fell off $306,900 in gold, but there was an increase in total output from the hydraulic, drift, and surface placers of $551,572 in gold, or $244,672 more than the decrease in the dredge yield. Of the total placer gold the 60 dredges yielded $7,783,394, or 86%; the 105 hydraulic mines, $702,884, or 8%; the 70 drift mines, $329,948, or 3%; and the 105 surface or sluicing mines, $264,623, or 3%. There are now 60 gold dredges operating in the state, and since the commencement of dredging in California in 1898, the total gold yield from this source to the end of 1914 has been $71,307,766.

Of the total ore milled in California from deep mines, 1,243,529 tons, or 62%, came from the mines in the five Mother Lode counties of Amador, Calaveras, El Dorado, Mariposa, and Tuolumne. This ore yielded, on an average, in gold and silver, $5,075,552, or $4.08 per ton.

The mine production of silver in California in 1914 was 1,471,859 fine oz. Of this, 1,436,982 oz. was won by deep mining. The larger part of the output, 1,267,752 oz., was derived from crude smelting ore. The greatest output was made, as usual, by Shasta County, where the yield from the smelting of copper ores was 592,727 oz.; from siliceous ore, 33,220 oz.; and from placers, 1,007 oz.; a total for the county of 626,954 oz., valued at $346,706.

The copper produced from California ores in California in 1914 was 30,507,692 lb., a decrease of 4,067,315 lb. Copper was produced in Amador, Calaveras, Imperial, Inyo, Mariposa, Mono, Placer, Plumas, Riverside, San Bernardino, and Shasta Counties.

The yield of lead in 1914 was 4,251,923 lb., an increase in quantity of 737,581 lb., and in value of $11,194. Most of the lead was derived from Inyo County, though some came from Shasta, Kern, and Placer Counties. The zinc production in 1914 was 389,471 lb. In 1914 only three mines produced zinc, all in Inyo County.

Missouri's Investigation of the Alleged Zinc-Smelting Trust

JOPLIN CORRESPONDENCE

The state investigation of the alleged zinc-smelting trust in Missouri was started in Joplin, Sept. 14. The opening session was conducted by John B. Ewing, assistant attorney general. Senator Frank W. McAllister is sitting as a special commissioner named by the supreme court. The hearing is being conducted to determine if there exists sufficient evidence of the violation of the trust laws of Missouri to warrant the state legal department in entering and prosecuting complaints against the several zinc-smelting companies engaged in business in the state. The real cause of the present investigation was the agitation started last February in the zinc-ore producing districts by some dissatisfied producers. This resulted in demands for an investigation being placed before Attorney-General Barker. The dissatisfaction arose from the fact that, when the ore market reached abnormally high levels and normal prices were more than doubled, the generally used basis of buying ore, based on the current market price of spelter which usually figured a ratio of 8 to 1, began to decline and dropped as low as 5 to 1, causing much dissatisfaction among the producers, who became convinced that the buyers of zinc ore were in a combination to hold down the price and stifle competition.

Representatives of the Illinois Zinc Co., American Zinc Lead and Smelting Co., Edgar Zinc Co., Mineral Point Zinc Co., Prime Western Spelter Co., Grasselli Chemical Co., Hegeler Zinc Co., Joplin Separating Co. and the Matthiessen & Hegeler Zinc Co. were present at the hearing. These present were only a small portion of the smelting companies engaged in business in Missouri.

Many witnesses were summoned, but only a few of them could be found in time for the hearing. Charles T. Orr declared that no important difference was ordinarily observable between bids of competing ore buyers on the highest grades of ore. On lower grades, he said, the variation in bids was sometimes considerable.

Very little testimony, beyond that tending to show there is no great variance between the prices offered for standard zinc ores in the southwest Missouri district by buyers for smelting companies, has been so far offered. That this condition was brought about by caution on the part of the buyers and a long-established custom of not interfering with one another's customers was the only explanation offered by witnesses.

Several buyers, who have represented smelters here during many years, testified that they act very largely on their individual judgment, without instructions from headquarters as to prices. The variation between bids on low grades of ore was generally admitted to be greater. Every buyer examined denied that the buyers, of whom about 14 are stationed in the district, ever held meetings. No testimony to show that meetings were held has been introduced.

Several of the largest ore producers and buyers were examined, but no evidence was secured showing any violations of the Missouri anti-trust laws. There was a decided lack of coöperation and interest on the part of the operators toward the investigation. In fact, the absence of mine operators from the sessions of the hearing has been its one conspicuous feature.

Attorney-General Ewing examined such witnesses as could be secured. The examination of mine operators and ore buyers was brought to a close Sept. 15, with the inspection of a batch of the buyers' correspondence requisitioned by Attorney-General Ewing, who hoped to determine the method employed by the buyers in fixing the weekly ore prices. This part of the investigation was conducted privately. Further investigation of the alleged zinc-smelting trust will be conducted in St. Louis on Sept. 21, at the Planters Hotel.

Nevada Metal Production, 1914

The production of gold, silver, copper, lead and zinc from Nevada ores sold or treated in 1914, according to the United States Geological Survey, was valued at $29,300,842.

The output of recoverable gold from Nevada mines in 1914 was 555,402.47 oz., valued at $11,481,188, and of this amount 87.29% was derived from dry or siliceous ore. The placer-gold output was 18,250.05 oz., of which 10,345.04 oz. came from placer mines in Nye County. The dry or siliceous ores contained 484,796.46 oz. of gold; copper ores, 49,476.61 oz.; and lead, zinc, and copper-lead ores contained 2,879.35 oz. Bullion from gold and silver mills contained 439,919.37 oz.; concentrates, 41,686.38 oz., and crude ore shipped to smelters, 55,375.09 oz. The mines of Esmeralda County produced nearly one-half of the total gold, or $5,226,367, and the Goldfield district yielded $4,705,210 of this total. Nye County produced $3,377,262 in gold; the Tonopah district yielded $2,648,833; the mines of the Comstock lode produced $434,387 in gold, and Humboldt, Mineral, White Pine, and Churchill Counties, in the order named, each produced more than 15,000 oz. of gold.

For three years prior to 1914 the silver output of Nevada had been steadily increasing, but on account of the low prices of the metal in the last half of the year 1914 there was a slight decrease in silver. The total output was 15,455,491 oz. valued at $8,546,887. Of this total yield 14,724,094 oz., or 95.3%, was credited to siliceous ores; 286,935 oz., to lead ores; 181,733 oz., to copper ores; and 115,138 oz., to lead-zinc ores. Ores treated at gold and silver mills were credited with 12,100,494 oz.; concentrates, with 1,721,348 oz.; and crude ore, with 1,600,315 oz. Nye County produced 11,424,769 oz.; the Tonopah district produced 11,388,452 oz., or 73.7% of the entire silver production of Nevada; the Comstock lode, or Storey County, yielded only 278,599 oz.; Churchill County's output was 1,545,926 oz.

In 1914 Nevada produced 60,986,450 lb. of copper. The greater part of the copper, 50,366,650 lb., came from concentrates, while 10,551,000 lb. was from crude ore shipped to smelters. The mines at Ely were operated at a reduced rate, and the Mason Valley smeltery was idle during a good part of the year.

The lead output of the States was 12,809,655 lb. Clark and Lincoln Counties continued to outrank all others in the production of lead, the combined output of these two counties being 10,193,098 lb. White Pine County yielded 915,602 lb. and Elko County 860,826 lb. The yield of lead from concentrates was 3,937,126 lb., and that from crude ore 8,794,246 lb.

The zinc ores of Nevada produced 12,980,232 lb. of recoverable zinc figured as spelter. Clark County produced 11,862,149 lb. of the entire zinc output, the remainder coming mostly from Lincoln County although small shipments were made from Eureka County during the year. The greater part of the zinc material is oxidized. From crude zinc ore shipped, 6,116,898 lb. were recovered, and from concentrates 6,863,334 lb. were recovered.

There were 731 producers of gold, silver, copper, lead, and zinc in Nevada in 1914. Of the total of 4,522,022 short tons of ore sold or treated, 1,461,577 tons was treated in gold and silver mills, principally cyanide mills; 2,768,193 tons was concentrated, and 261,018 tons shipped to several smelters. The largest part of the total tonnage, 2,882,121 tons, represented copper ore; 1,594,486 tons was siliceous ore; 16,088 tons, lead ore; 9,490 tons, zinc ore; 3,762 tons, copper-lead ore; and 16,075 tons, lead-zinc ore.

Japanese Mineral Output, First Five Months of 1915

According to the Department of Agriculture and Commerce, the Japanese production of minerals for the five months, January to May, 1915, was as follows:

Item	Amount	Change from 1914
Gold	3,079 kg.	I. 2.2%
Silver	59,979 kg.	I. 1.3%
Copper	26,895,887 kg.	I. 4.0%
Iron	19,917,887 kg.	D. 30.5%
Coal	7,681,407 tonnes	D. 9.0%
Crude oil	178,878,780 liters	I. 23.7%
Sulphur	22,331,817 kg.	D. 6.2%

Editorials

The Definition of "Smelting"

Careless use of words sometimes breeds trouble, an interesting example of which recently happened. In the vernacular almost every kind of an ore-reduction works is either a "mill" or a "smelter." The idea of the mill is a plant wherein the ore is crushed for the mechanical separation of its mineral constituents, or a stamp amalgamation mill, or a plant for the extraction of the precious metals by chlorination or cyanide lixiviation. Almost everything else is a "smelter," and especially is the idea of a smelter associated with the buying of ores in lots on samples. Thus we read of ore going to smelters who in reality are merely magnetic-separators, etc.

Recently an item was published in the news pages of the *Journal*, as well as in several daily papers, to the effect that the Weedon Mining Co., Ltd., of Quebec, was going to build a "zinc smelter" at Welland, Ont. The company has written to us that it has suffered much annoyance owing to this item. Among other things the farmers of the vicinity of Welland rose in protest against the project. In fact the company was going to erect a plant for the hydrometallurgical-electrometallurgical extraction of zinc. In the eyes of the news reporters this was a smelter, and hence the tr uble.

Just what is a definition of smelting? On this subject lexicographers are vague. The process of reducing lead, copper and iron ores in the blast furnace is unquestionably smelting. Here are conveyed two ideas—namely, (1) the reduction and fusion of a metal and (2) the scorification and fusion of the gangue or the impurities. The production and discarding of a slag seems to be an essential part of the conception. In the treatment of metallic products the proportion of slag may be very small and the process is commonly described as "refining." A man who treats the black precipitate from the cyanide process is never called a "gold smelter." He is a gold refiner. In the reduction of zinc ore in the ordinary way there is necessarily only one of the two main ideas of smelting. The metal is reduced and drawn in molten state, but the gangue of the ore is not scorified and fused if the metallurgist can help it, and in many cases he can. The British call the zinc smelter a zinc distiller, which is precise.

In the reduction of zinc ore for the manufacture of zinc oxide by the Wetherill process, and similarly in the reduction of antimony ore by the Herrenschmidt process, there is neither fusion of the metal nor of the gangue. However, the processes are commonly called smelting and the operators thereof are smelters, although the only connection with the main idea is that they treat the ore in furnaces. If zinc is to be extracted hydrometallurgically and precipitated by electrolysis, there is not even that connection; for although the ore may have to pass through a roasting furnace that would not be necessary if it were an oxidized ore. The only furnace in the plant might be that for melting cathodes, which particular part of the process would be melting, not smelting, as everybody would agree.

Proposed Patent Reform

If there ever be any reform in the Patent Office procedure of the United States, there ought to be introduced a new form of letters patent. At present this document consists of two parts—the specifications and the claims. There ought to be a third—a synopsis of both. There might, moreover, be advantageously introduced some subdivisioning of the specifications. It would not be worth while to make these suggestions, or to give any attention to the subject, were it not that patent specifications are an important part of technical literature. The Patent Office authorities claim that they are the most important part—that every new discovery, new process, new idea is sooner or later recorded authoritatively in their office in the form of an application for a patent, and that in making any investigation it is scarcely necessary to search outside of their files. This is not absolutely sound, but there is no doubt a good deal of meat in it. But, admitting that, we submit that the patent files are forbidding and are cluttered with so much rubbish that it is very difficult for anybody—even for a skillled patent-examiner, we imagine—to find in them what he wants.

Let us illustrate. Our attention recently fell upon a newly granted patent for "Method of Smelting Sulphide Ores." This title in itself drags a red herring across the scent of the investigation. The patentee in fact describes a process for zinc smelting, but in order to have his patent as broad as possible he gives it the less definite title. We do not urge any encroachment upon the rights of an applicant. Let him take all that the law allows him. But why should not the Patent Office give to every patent an index title, with the understanding that it does not commit or limit the patentee?

This particular patent in specifications of 291 lines and claims of 160 lines (four pages of text) describes and protects a process that we summarize as follows:

Blende is crushed to minus-100-mesh size and is burned in suspension in the combustion chamber of a distillation furnace, its heat performing the distillation of a charge of ore in the retorts thereof. The products of combustion are conducted through a bag house (bags of asbestos fabric) and the zinc oxide collected therefrom is mixed with coal and charged into the retorts of the distillation furnace. The retort gases are conducted into the combustion chamber of the distillation furnace to assist in the distillation of the zinc.

The claim might be: "The combination of the above steps, and specifically the burning of blende in suspension and the utilization of the heat thereof for zinc distillation."

We shall not discuss the practicability of this ingenious conception of making zinc-sulphide ore do its own smelting or suggest a study of the respective exothermic and endothermic reactions involved; but we submit that all that anybody skilled in the art of zinc smelting needs to know is comprised in our summary,

which might be even more brief. Such a summary ought to be printed as the introduction of every patent specification.

The patent upon which we have commented is manifestly the protection of an idea. There are other patents which are based upon observations of things that happened. A process patent should be subdivided in some such way as the following:

Review of State of the Art: The inventor and his solicitor usually consider it to be necessary to go into this at length. Thus is the reader told repeatedly in zinc-smelting patents that blende is finely crushed, roasted, mixed with coal, and distilled in small cylindrical retorts, with certain drawbacks such as excessive use of fuel and labor, imperfect extraction of zinc, production of blue powder, etc. The Patent Office might usefully adopt a set of standard summaries of the state of each art and in prefacing each new specification with the appropriate one the labor of the drawer of the patent would be lightened and if properly subheaded, as it should be, the reader could skip it if he wanted to, as generally he would.

Next there should be a subhead, "Observations," under which the applicant should tell what he had learned in the laboratory, in the works, or elsewhere. This would be the star feature of many patents. At present it is not given sufficient prominence. Take the famous Everson flotation patent, for example. How much more impressive would it have been if the experiments that the applicant had really made had been brought out in a striking way. In later years they were dug out, to be sure, but there are thousands of dusty, pigeonholed patents which contain scraps of useful information that nobody knows about. The proper exposition of such in the patent office papers would be a real contribution to technical literature.

Finally there should be the subhead of the "Proposal," the way the applicant aimed to do something new and useful, based upon his observations and ideas. In the cases of many process patents there would of course be no subhead "Observations." In such patents a subhead, "Ideas," might well be introduced.

Technical men are generally wishful that there be not so many patents as at present, so many of them being upon mere combinations of steps that would be obvious to anybody who had to take them; but temperateness in the dissipation of paying money for patent fees is probably too much to hope for, although progress in this, as in the prohibition of alcoholic drinking, may gain unexpected headway. In the meanwhile, however, conditions will be somewhat ameliorated if patent specifications and claims be reformed in the ways herein suggested.

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Notes About Copper Selling

So long as the war continues, deranging the ordinary machinery of commerce, nobody need be surprised by erratic conditions in the commodity markets, especially those of international character, like the copper market. It is interesting to review some recent features and comment on some current factors.

A little while ago we boasted that we were going to emancipate ourselves from the London standard market. Moreover, that we were going to sell copper in dollars and cents, nevermore in pounds sterling. We are obliged to admit that the wish was father to the thought—that we cannot do what we hoped.

The rise and fall of standard copper in London still sways sentiment here—partly through the medium of Wall Street, partly otherwise—no matter whether it ought not to.

We ought to be able to say that Europe must come to us for copper and must pay us in dollars and cents if we demand it; but when we try to put such a policy into effect, we find that we are simply playing into the hands of the London dealers who will sell European consumers in the way they are used to, and we run the risk of losing our own customers.

The violent fluctuations in the rate of exchange have greatly increased the element of gambling in selling copper for delivery abroad. Thus a pound of copper sold on the basis of £86 realizes nearly 18.05c. if exchange be 4.70 and only about 17.85c. when exchange is 4.65. There were recently sales of copper to domestic consumers at 17¾c. per lb., netting the seller about 17.55c. after deducting discount and freight charges. At the same time the same sellers were willing to sell for export at £86, and did so, which with exchange at 4.65, as it was then, corresponded to 17.85c.; and after deducting c.i.f. charges netted 17.25c. to 17.35c. here.

This difference in price was a feature right along in the recent dull market. Producers were stiff in their attitude toward domestic buyers, but were willing to take less from foreign buyers. Let anybody figure this out as he wants to. Of course about half of the domestic production of copper has got to be sold abroad anyhow. The British pundits who have seen malevolence in the attitude of the American sellers of spelter may like to explain the generosity of the sellers of copper.

There have indeed been three prices for copper of late, on an ascending scale—namely, the price to European buyers, the price to domestic consumers, and the Wall Street price. The last has been pretty steady at 18c. per lb., although there have been threats that it might go to 20c.

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The strike of copper miners in the Clifton-Morenci district has turned out to be serious, the several mines and smelteries having been formally put in the hands of the sheriff, who thus has the responsibility of preserving them. Elsewhere among the copper mines there has been remarkable peace and contentment. The bitter strike at Lake Superior and the amusing affair at Butte cleared the atmosphere. The policy of paying the men on a sliding scale corresponding to the price for copper, introduced in many districts, has proved a good one. It is a simple and satisfactory system of profit-sharing, which makes the men feel that they are partners in the business.

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The investigation of the alleged zinc-smelting trust opened at Joplin, Mo., last week has already resulted in a fiasco, as everybody of good information knew it would. Only two or three mine operators took the trouble to attend the hearing, and none of them had any evidence of importance of offer. Several ore buyers for smelters testified that the there had never been collusion among themselves, but that they had simply bought ore for their

principals as cheaply as they could. Perhaps the most remarkable thing is the way the smelters turn these men loose in the district, telling them only to buy a certain tonnage of ore and not to exceed a certain price, and leaving the rest to their judgment, skill and honesty. There have rarely been cases of misplaced confidence. The ore buyers of the Joplin district are a good lot of men.

BY THE WAY

The ill-fated Quebec bridge is now being melted down by the Canadian Car and Foundry Co. for use in making shrapnel. The mistake of the civil engineers is furnishing additional employment for the metallurgist.

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The mining and metallurgical gentlemen who are interned in the Douglas Aliens Camp, Isle of Man, Great Britain, find time heavy on their hands and have appealed for American books and journals about minerals and metals that can be spared by generous members of the fraternity in this country. Dr. W. A. Dyes (address Douglas Aliens Camp, Isle of Man, Great Britain) will attend thankfully to the distribution of any literature of this kind that may be sent him.

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The word "terrain" is frequently being used in the war news of today, and although a foreign military word it is becoming common in civilian use, as it has long been in army parlance. Terrain means, according to the "Century Dictionary," a part of the earth's surface, limited in extent considered with reference to its fitness or use for some special purpose, as for a battlefield. The word, although little used, heretofore, is so expressive that it will often be employed to designate territory under consideration and will soon become familiar in the English vocabulary.

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"On a raft 100 ft. underground two bandits at Webb City, Mo., who held up street-car conductors on Sept. 19, paddled to safety through abandoned mine shafts. The mines had been flooded a few days before when a big levee along the river near by collapsed. The bandits floated for six miles underground, climbed to the surface and fled," says the New York *Tribune*. "The men, both masked, held up three conductors near the car barns and got $200 in money and watches. Bloodhounds were put on the trail, which led to the mouth of an abandoned mine. Officers found traces of the men having hastily constructed a raft. The hounds picked up the trail again at the mouth of another shaft, but too late to overtake the men." Thus do the dime novels of our boyhood come to pass in real life.

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About Oct. 1 the headquarters of the statistical bureau of the American Iron and Steel Institute will be removed from 261 South Fourth St., Philadelphia, to 61 Broadway, New York, where the general offices of the institute are. The building in Philadelphia was first occupied by the American Iron and Steel Association under the direction of James M. Swank as secretary about Jan. 1, 1874; when the association was merged in the institute at the beginning of 1913, the statistical department was continued at the Philadelphia office. The building, which was originally a dwelling house, is plain and simple in its exterior and in all its fittings and furnishings, but it served its purpose well for 42 years and many of the older members of the association will learn of its abandonment with regret. The new offices are in the 36-story skyscraper of the Adems Express Co. in New York.

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To the students of union-labor activities the following will doubtless prove of interest: It is very probable that before very long all union workmen dying in Hudson County, N. J., will have to have union funerals. They will be laid out by union embalmers in union caskets, carried by union pallbearers to a hearse driven by a union driver, and buried in a grave dug by union gravediggers or else cremated by union cremators. William F. Kavanagh of the Central Labor Union of Hudson County declared that such will be the rule if the resolution he proposes to introduce at the next meeting of the union on Thursday evening, Sept. 17, is passed. "It is entirely consistent with trade unionism that the bodies of men who were loyal to the cause of union labor should be handled by none but union men," according to Kavanagh.

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The naming of Virginia City, Nev., is related in the *Saturday Evening Post* of July 31, 1915, in Charles E. Van Loan's interesting distillations of his conversations with the "Oldest Inhabitant." In the autumn of 1859 the town acquired a name. "And there was something queer about that," says the Oldest Inhabitant. "There used to be an old prospector round here named Fennimore. They called him Finney for short, and sometimes Ole Virginny on account of his always talking about his native state. Finney liked his liquor pretty well, and one night he fell and broke his bottle. He poured out the drop or two that was left—poured it on the ground. The boys asked him what he was doing. 'I'm christening this camp,' says he. 'It's time she had a real name and from now on she's Virginia Town.' When the postal authorities sent out the cancellation stamps, 'Town' was changed to read 'City.' Old Finney made an awful row about that, but the Government outheld him and Virginia City she was."

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Reuter's agent at Zurich states that agents are conducting a diligent and systematic hunt for copper throughout Switzerland, according to the London *Financial Times*. They are penetrating the mountains to the remotest valleys and persuading the peasants to part with this precious metal. Taking advantage of the ignorance of these country people they tell housewives that their copper utensils are burned out and offer to give them new pots and kettles in exchange, which of course prove to be of greatly inferior metal. The business is enormously profitable, since the agents pay only 2d. to 4d. a lb. for copper which they sell to Germany for ten times as much. The Germans are constantly finding new ways of getting copper from the Swiss. There are no brass smelters in Switzerland and taking the advantage of this the Germans insist upon receiving an equal amount of copper for every delivery of brass. And as the copper in brass weighs only one-half to two-thirds as much as the brass, a surplus is thus obtained.

PERSONALS

Leo Von Rosenberg, of New York, is in eastern Oregon.

Kirby Thomas, New York, has been in the Tintic district, Utah.

Prof. F. W. Sperr of the Michigan College of Mines has gone to California.

Henry Krumb and F. S. Schmidt, of Salt Lake City, Utah, are in Alaska reporting on several properties.

A. I. D'Arcy, general manager of the Atlanta Mine has returned to Goldfield, Nev., after having visited different places in California.

Charles W. Newton, superintendent of the Consolidated Interstate Callahan Mining Co., Wallace, Idaho, spent several days in Spokane this week.

W. Ray Cox, who for several years has been a mineral inspector of the General Land Office at Portland, Ore., has been appointed professor of Mining and Metallurgy in the School of Mines at the Oregon Agricultural College, Corvallis, Oregon.

W. R. Coleridge Beadon, who has been engaged in mine management and engineering for the past 18 years in Montana, India and Burma, chiefly for John Taylor & Sons, London, is now investigating the possibilities of old gold workings in the highlands of the Dekkan in India.

The New York Section of the Mining and Metallurgical Society of America held its annual election of officers at the Machinery Club on Sept. 16. J. E. Johnson, Jr., was elected chairman; A. H. Rogers was reëlected vice-chairman and D. M. Liddell, reëlected secretary-treasurer.

F. C. Cheney, mining engineer of Cleveland, Ohio, aged 21, formerly assayer and surveyor at the Hudson Bay Mine, Cobalt, but recently with the Dome Lake, Porcupine, Ont., disappeared on Aug. 23. On that date he left Timmins to go to the Dome Lake, and called at the Schumacher and Dome mines, but has not been seen since, though an extended search has been made for him.

J. M. Turnbull, of Trail, B. C., has been appointed professor of mining in the University of British Columbia. Mr. Turnbull for years has been a mining engineer with the Consolidated Mining and Smelting Co. of Canada, Ltd., graduated from McGill University, Montreal, in 1897. During the long period he has been associated with the Consolidated he has had a close and extensive experience with the productive mining industry of British Columbia, besides which in his capacity of examining engineer he has travelled throughout the various districts of the Province, so that he has acquired much valuable information relative to its mineral resources.

OBITUARY

John Cameron died at Virginia City, Nev., Sept. 4, aged 75 years. He was for many years connected with the Yellow Jacket Mine on the Comstock.

William H. Woodward died recently at Park City, Utah, aged 74 years. He had been for over 30 years a prospector and operator in that district and had located several important mines.

James Hendrickson was killed in the Albion tunnel at Alta, Utah, Sept. 16. The miners struck a heavy flow of water on that day, which was followed by a large volume of carbon dioxide. Mr. Hendrickson, with another man, both armed with oxygen helmets, went into the tunnel to open up the air line, but was overcome, notwithstanding the helmet. He was a mining engineer, a graduate of Columbia University and had been in Colorado and Utah about 12 years past.

SOCIETIES

American Institute of Metals—The ninth annual meeting will be held at Atlantic City, N. J., Sept. 28-Oct. 1, and will be a joint meeting with the American Foundrymen's Association. Many interesting papers are promised.

American Electrochemical Society— A meeting of the New York section was held at the New Grand Central Palace, Sept 25. The speakers of the evening were: John Barrett—"The Great Pan American Opportunity." Thos. H. Norton—"The Possibilities of Niagara for American Electrochemistry."

Franklin Institute, Philadelphia—The program of lectures to be delivered at the 1915-1916 meetings has been published. Among them are the following relating to metallurgical subjects: Oct. 20, 1915—"Recent Progress in the Metallurgy of Copper," by H. O. Hofman. Dec. 2, 1915—"Magnetic Investigations of Iron and Steel," by John D. Ball. Dec. 9, 1915—"Smoke as a Source of Atmospheric Pollution," by W. F. M. Goss. Mar. 30, 1916—"Some Problems in Physical Metallurgy at the Bureau of Standards," by George K. Burgess. Apr. 6, 1916—"Use of Powdered Coal in Metallurgical Processes," by C. J. Gadd. Apr. 13, 1916—"Heat Measurement as Related to the Industries," by Charles W. Waidner.

Yale Engineering Association—There has been recently formed an organization among graduates of Yale University known as the "Yale Engineering Association," the purposes and objects of which are clearly set forth in a circular letter which has been widely distributed to Yale graduates. The officers of the Association consist of: President, Edwin M. Herr, Westinghouse Electric and Manufacturing Co.; vice-president, Harry N. Covell, Lidgerwood Manufacturing Co.; secretary-treasurer, Richard T. Dana, consulting engineer

While any Yale graduate is eligible for membership, yet the association naturally appeals more strongly to those who are engaged in engineering pursuits, transportation or manufacturing. It is proposed to hold the first meeting of the association in New Haven the early part of November.

American Mining Congress—The meeting of this body was held in San Francisco, Sept. 20-22. The provisional program provided for the opening session on Monday morning, Sept. 20, and for the afternoon address on "What the United States Bureau of Mines is Doing and Hopes to Do for the Metalliferous Mining Industry," Van H. Manning; "Plain Writing," Dr. George Otis Smith; "Federal Influence in the Settlement of Industrial Disputes," Dr. Martin D. Foster.

Tuesday's sessions were devoted to reports of Committees on Prevention of Mine Accidents, on Uniform Mine Reports, on Alaskan Affairs, and on Revision of Mineral Land Laws. Papers were: "Rights of Way Over the Public Domain," Hon. Charles S. Thomas; "The Right of Appeal from Decisions of the Interior Department in Cases Where the Government is Charged with an Interest," H. H. Schwartz; State versus Federal Leasing of Natural Resources Where Government Control is Essential to Public Welfare" (general discussion); "California's Water Infiltration Law," Fletcher McN. Hamilton.

At noon memorial exercises in honor of the late Dr. Joseph A. Holmes, Chief of the Bureau of Mines, were held.

In the evening the business meeting and election of officers were held.

The sessions on Wednesday, Sept. 22, were devoted to reports of the Committee on Resolutions, on Mine Taxation, on Mining Investments, on Freight and Ore Treatment Rates. Papers and addresses on "The Development of Mine Taxation in Arizona," G. H. Dowell; "Mining on Government Indian Reservations," F. Lynwood Garrison; "Workmen's Compensation Insurance and the Coal Mining Industry," Herbert M. Wilson; "The New Plan of Mining Insurance," David Ross; "Mining Hazards on the Pacific Coast," Dr. F. L. Hoffman; "The Iron Resources of Utah," Prof. Fred J. Pack; "The Future of the American Zinc Industry," Otto Ruhl; "Interesting Phases of the Anthracite-Mining Industry," Dr. E. W. Parker; "Federal Control of the Coal Mining Industry," including a discussion of the Sherman Law, the Clayton Bill, and the Federal Trade Commission, Rush C. Butler.

On Wednesday evening a complimentary banquet tendered to Van. H. Manning, the new Director of the United States Bureau of Mines.

TRADE CATALOGS

The James Quartz Mill & Crusher Co., Denver, Colo. Catalog No. 12. Quartz Mills and Crushers. 20 pp., illus., 6x9½ inches.

The Brown Hoisting Machinery Co., Cleveland, Ohio. Catalog U. Brownhoist Transfer Cars and Larries. 32 pp., illus., 6x9 inches.

Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill. Bulletin No. 72. Sullivan Drill Sharpener. 24 pp., illus., 6x9 inches.

The Electric Storage Battery Co., Philadelphia, Penn. Handbook H L. Low Voltage Isolated Electric Light and Power Plants with the Chloride Accumulator. 52 pp., illus., 6x9 inches.

Editorial Correspondence

SAN FRANCISCO—Sept. 15

Patrick Creek Copper Mines, owned by W. Duley and O. B. Lauff, of Crescent City, have been taken on a purchase option by George P. Reuter and Arthur A. Slobbling, of Portland, Ore. The mining districts in Del Norte County have the great disadvantage of lack of adequate transportation. The only travel or connection is by steamer to San Francisco or Portland and Seattle. The proposed railroad now under construction from Grants Pass, Ore., to Crescent City will put the Del Norte districts in direct transportation connection with the Southern Pacific and will aid very largely in the development of the copper ores in Del Norte and Siskiyou Counties. The Queen of Bronze mine in Josephine County, Ore., and the Britten mine in California are shipping copper ore to Kennett, by way of the new railroad. The possibilities of northwestern California and southeastern Oregon will soon be made evident, and if the proper methods of development are applied to that region, they will add very largely to the future gold and copper production of the Pacific Coast.

Semi-Monthly Pay Day provided for by law passed by the last legislature does not appeal to miners generally. At the Argonaut in Amador County, the company has proposed to make the semi-monthly pay day optional with the men. Those who wish their money twice a month instead of once will be accomodated. It is probable that the majority at this and other Mother Lode mines will express their preference for the monthly pay day. Miners can see very little merit or advantage in the law, especially when working for reliable operators, and they are not much disposed to changing their habits in the matter of paying their bills which formerly have been settled once a month. So far as the mine owners are concerned, the law necessitates more labor in the clerical departments and some inconvenience probably, but this is of no great importance so far as it affects the industry generally. Mine owners and employees are not the only persons to be considered under this law. In fact they furnish rather a small proportion. There are other industries whose employees will be very largely benefited by semi-monthly pay days, and the law was meant for their benefit, without particular consideration of the mining industry. At any rate the industry will not suffer by reason of the law and it is not going to disturb mining men enough to make a fuss about. By the active work of the California Metal Producers Association, and its friends in the lobby of the last legislature, some very bad bills were killed and while some bills got by which are not particularly to the advantage of the industry, mining men have nothing particular to grieve about and should be very well satisfied with present conditions. The mine-safety rules are being got into good shape, the mine-insurance rates have been reduced, and altogether the mining industry has fared better than it has in a good many years past so far as legislation affects it.

DENVER—Sept. 16

A New and Standard-Gage Route into the San Juan mining region is being sought by the Denver & Rio Grande Ry. Engineers believe they have found a practicable route starting from the station of South Fork, between Del Norte and Creede, following up a water grade, crossing the San Juan Mountains in Mineral County and then traversing the rough prairie to Durango. President B. F. Bush and party of railroad officials have been touring the proposed route by wagons.

Charges of Fraud that had been preferred by Rufus C. Elder and Frank E. Mann against Samuel D. Nicholson, Julius Rodman and John A. Ewing, all prominent in Leadville mining, were dismissed by Judge John A. Rimer of the U. S. District Court, Denver. This suit was brought a year ago by executors of the estate of George W. Elder, a stockholder in various Leadville mining companies controlled by the above defendants and allied with the Guggenheim interests.

The Denver Branch of the United States Mint, according to Thomas Annear, superintendent, is the storehouse of upward of $465,000,000 worth of coin and bullion. He believes that Colorado will during 1915 produce from $8,000,000 to $10,000,000 more in gold and silver than it did last year. For the past four months, the mint receipts from Colorado mines have been nearly 25% above normal. More bullion is stored in the mint at Denver than in any other building in the world, it is believed. The coinage department is at present making only silver quarters.

Entire Holdings of the Tin Cup Gold Dredging Co. were sold, Sept. 2, by the United States court of bankruptcy, Denver. The property comprises a fine hydro-electric power-generating plant at St. Elmo, in Chaffee County; a transmission line thence over the continental range to Tin Cup, in Gunnison County, about 16 miles; a complete gold dredge with 3½-cu.ft. buckets; 2,300 acres of dredgeable ground; and a complete equipment of buildings, churn drill and tools. This valuable outfit was sold for $5,000 to Colorado Springs parties. One more recorded instance of failure in a promising mining enterprise resulting from management by inexperienced men and a heavy promotion overload. The complete outfit was never given a reasonable chance to operate.

BUTTE—Sept. 14

Although the Butte Mining Companies Paid in wages in August about $350,000 less than they did in July, nevertheless the payrolls last month aggregated $1,700,000. July was the biggest month in the history of the Butte mines, so far as the payment of wages is concerned, although the output of copper and the net earnings were not nearly so large as during some previous months. There are fully 13,000 men employed in the Butte mines and the rate of wages fell from $4 to $3.75 per day because copper sold under 17c. in August, the rate of wages being based on the price of copper. The Anaconda company alone paid out $1,180,000 for wages in August. The Butte & Superior paid out $170,000, which was about $5,000 less than in July, and the North Butte paid $93,000, the East Butte $90,000, the Butte-Ballaklava $15,000 and the Clark properties $60,000. It is estimated that the mining companies and other employers of labor in Butte pay out a total of $2,600,000 in wages each month.

The Output of Copper is being gradually increased by the mining companies but the total is still far from what it was a few years ago. The Anaconda company official report of August production shows the output to have been 22,800,000 lb., the largest production of any month this year, and that includes the output of the North Butte company, nearly 1,800,000 lb., and some other custom product. During the other months of the present year the Anaconda company reported production as follows: January, 13,700,000 lb.; February, 15,100,000 lb.; March, 19,000,000 lb.; April, 21,800,000 lb.; May, 20,500,000; June, 22,100,000 lb.; July, 22,100,000 lb. In August of last year the output was but 14,750,000 lb., and in 1913 it was 22,500,000; in 1912, 25,250,000 lb. The copper-producing companies now are the Anaconda, North Butte, East Butte, Butte-Alex Scott, Elm Orlu, Davis-Daly, Butte-Ballaklava, Pilot-Butte and Tuolumne. About the only development company operating in Butte at the present time is the Rainbow, a Cole company, which is engaged in developing the Rainbow and Butte & London properties. Sinking was resumed in the Rainbow shaft a few weeks ago and in the Butte & London last week.

SALT LAKE CITY—Sept. 16

The Salt Lake Stock and Mining Exchange appointed delegates to the National Brokers Convention in San Francisco, Sept. 21 and 22, as follows: George H. Dern, W. D. Nebeker, J. C. Dick, Fred C. Dern, and J. A. Hogle. Messrs. G. H. Dern, Dick and Nebeker have also been appointed delegates to the American Mining Congress, which meets at San Francisco during the same week.

SEATLE—Sept. 15

Lower River Claims are Showing Up Well under development, an average of 50c. a yard being obtained from the claims in the open cuts. Considerable activity is also in evidence in the camp. About 36 operators now are busy doing development work.

The Strike Among Miners at Long, near Ruby, has closed down many placer claims, and only two employing concerns are operating on Long and Bear Pup Creeks. A good many of the men affected by the strike are scattering to other creeks and some are leaving the district entirely. The operators offer to pay $4 a day for mucking, but the men

want $5 and have struck to enforce their demands. At present there is no indication of a compromise, as the mine owners say the ground will not stand the wage scale.

WALLACE—Sept. 17

The Controversy Between the Hercules Mining Co. and the American Smelting & Refining Co., which has been occupying the attention of this district for the last three months, still affords material for much interesting speculation. Having failed to secure a satisfactory contract for the treatment of its ores, the Day interests, which control the Hercules, opened negotiations for the old Northport smeltery, near the British line in the State of Washington, owned by an English company. These negotiations resulted in the purchase of the plant by the Days for $80,000. The plant has long been idle and is said to have originally cost over $1,000,000. The Days evidently intend to embark in the smelting business, not only handling the ore of the Hercules and other mines they control, but will do a custom business also. The smeltery was built to handle copper ores and is now being remodeled to treat lead ores also. There are a number of interesting features in connection with this move on the part of the Days, and the belief still prevails in some quarters that the purchase of the Northport plant was merely a bluff to force the A. S. & R. to make concessions to the Hercules. The owners of the Hercules are not a unit on the smelting proposition. The company is not incorporated and it is known that at least two of the large owners, August Paulson and L. W. Hutton, of Spokane, have declined to go into the smelting enterprise. It was therefore up to the Days, Harry L., Eugene R., and Jerome J., to furnish the sinews. It is now learned that the funds for the extensive work that is going on in rebuilding the Northport plant are being provided by the Tamarack & Custer Consolidated Mining Co., which is controlled by the Days. This company is incorporated under the laws of the State of Nevada, which it appears give practically unlimited powers to the three members of the executive board. This company has a large ore reserve and for several years has been operating steadily, but has never paid a dividend. Its surplus is estimated as high as $600,000 and it appears that this money is to be used to overhaul and restore the old smeltery to a condition of activity. Another interesting feature of the situation is that Harry L. Day, one of the brothers who dominate the Hercules and Tamarack & Custer, is still president and general manager of the Federal Mining & Smelting Co., a subsidiary of the American Smelting & Refining Co., with which the Days are now at loggerheads and with which they are preparing to compete in the smelting of Coeur d'Alene ores and the ores of other districts.

CHISHOLM, MINN.—Sept. 18

With the "Safety-First" Idea in mind, the Oliver Iron Mining Co. is experimenting with a small attachment on the shoes of its surface timber crew, to permit of greater ease and safety in getting over the logs. The device is a small piece of sole leather with a spiked plate, and is detachable. It has been found a good safeguard against loss of footing because of loose bark, rolling logs, snow, ice, etc.

DULUTH—Sept. 18

Bathtubs in Miners' Cottages are to be tried on the Mesabi range. At Chisholm, a local plumber has been given a contract to install bathrooms in 11 company houses of the Oliver Iron Mining Co. in Monroe Location. This is in line with the welfare work being done by the company.

Taxes and Penalties aggregating $67,794.84 have been paid by the Oliver Iron Mining Co. and Pickands-Mather Co. on mining property in Hibbing, Minn. Such taxes were paid only on mining property held under state leases, indicating that the operators propose to take no chances on the possible forfeiture of their state leasehold interests, as all state leases contain the usual clause requiring prompt payment of taxes. Officials of the above two companies, as well as the remaining nine operators, state that this small payment does not mean the abandonment of the fight against the alleged municipal extravagance of the Hibbing officials. No other part of the $1,500,000 tax levy has been paid by the mining companies.

HOUGHTON—Sept. 20

The Proposal to Consolidate Centennial with Osceola has not been heard from further, although the proposal is by no means dead. There have been two meetings of large shareholders, entirely independent of the Calumet & Hecla interests and at these it was determined not to go ahead with matter in hand until the results of the Tamarack proposal to sell out all individual holdings to the Calumet & Hecla should materialize or should be dropped. The belief is general that the average miner or shareholder in Calumet has a pretty fair knowledge of the conditions underground in both of these properties and Centennial shareholders are waiting to see what sort of a proposal the Calumet & Hecla is willing to accept from the Tamarack and then they will go ahead and make their proposal to the Osceola. W. E. Parnall, who was here making an examination of the Tamarack, in connection with the proposal to sell out, has completed his underground investigation and returned east.

The New Arcadian is now operating a small crew of men at a point 1,400 ft. south of present shaft. It is hoped to pick up the same rich amygdaloid that is now making such a continued good showing in each opening in the main shaft. The point where this preliminary work on a possible second shaft is going forward is the pit where work was undertaken 5 years ago. At that time the overburden was found to be 30 ft. deep and it was expensive work to get to the solid rock. This pit has been unwatered and the first blasts uncovered some good-looking amygdaloid, much like that taken from the first shaft. The conglomerate, presumably the Calumet, was shown in three points in the shaft and in two diamond-drill cores in previous records. Assuming that the amygdaloid is about the same distance east of the conglomerate in this mineral formation, present locality ought to disclose the formation in quantity and quality.

NEGAUNEE, MICH.—Sept. 19

There Will Be Very Little Ore Left in stock when the shipping season comes to a close this year. The piles at the Negaunee, Maas, Hartford, Rolling Mill, Mary Charlotte, Breitung Hematite and Queen Group will all be forwarded. These are the only operating mines at present, with the exception of the South Jackson, which is operated only during the summer months and which will ship about 60,000 tons this year. Negaunee is now in as good a condition as any city in the Michigan iron district, with a number of large mines, and all ore to be loaded and sent out. There should be no worry about the winter there. If it is true that the price of ore is to be advanced 50c. before next spring, the operators will want to get out all that they can and have it ready to ship. Higher prices also mean that some mines that are now idle are apt to be started up again. Some of the high-cost producers always have a difficult time breaking even when the market prices are low, but they are able to derive a profit when bessemer ore is selling above $4 and nonbessemer is above $3. The present prices are $3.75 for bessemer and $3 for nonbessemer.

GRAND RAPIDS, MINN.—Sept. 19

Operations in Itasca County are epitomized in the report of the mine inspector covering the period from Feb. 1, 1915, to July 1, 1915, just published. It shows that there are 21 mines in the territory and that 10 were operated during the period covered by the report. Six of them shipped ore during that time. Stripping operations were carried on by five companies. The Hill-Annex removed the largest amount of dirt during the five months, stripping 746,000 cu.yd. The Canisteo came second, with 214,000 cu.yd. Other mines stripping were the Bennett, Quinn-Harrison and the Hawkins. The greatest shipment of ore was from the Canisteo pit, at Coleraine, with 442,000 tons. Other shipments were as follows: Hill mine, 266,000 tons; Holman, 240,000 tons; Judd, 95,000 tons; Mississippi, 153,000 tons; Hawkins, 61,000 tons; Quinn-Harrison, 136,000 tons. During the period 1,285 men were employed. Of these 1,113 worked on surface. Only 172 were employed underground. There were but two fatal accidents during the five months, a far better record than for any previous period since the district was opened. Otherwise no one suffered serious injuries, fractures or amputations. The minor accidents were few in number. It can be clearly seen that the "safety-first" campaign is having good results. Since the period covered by the report, activities have been greatly increased. More mines are working and more men are employed. The outlook is very bright on that part of the Mesabi.

TORONTO—Sept. 18

From the New Kowkash Gold Field many prospectors have returned discouraged with the impression that there are few favorable indications outside of the original discovery. The expectations of claimholders have since been revived by another important find, distant 15 miles from the King Dodds discovery, from which rich samples are shown, which is regarded as indicating the extent of the field. While the geological formation is considered as favorable, there are few rock outcrops, and much stripping away of the overburden must be done before the value of the field can be determined. Under these conditions it is not likely that superficial prospecting will result in further sensational finds, and though prospecting parties are still going in, there is little disposition on the part of capitalists to make investments before the value of the field is established. The report of Percy Hopkins, assistant geologist of Ontario, which will probably be made public in a few days, is awaited with much interest.

The Mining News

ALASKA

PATTERSON AND FINLEY (Fairbanks)—Have made their fourth cleanup on Livengood creek. About 223 oz. of dust were taken out, netting $3,982, which averages $17.86 per ounce.

ROSS & BYRONS CLAIMS (Nome)—A four-horse team load of ore has been brought out and shipped to the Tacoma smeltery for treatment. It was blocked out of a quartz stringer in bedrock, 40 ft. from the surface, and has a high mineral content.

THOMAS-CULROSS (Valdez)—Has started development work on larger scale than heretofore, owing to extraordinary value of ore recently uncovered. Property is located near Thomas Bay, on Culross Island, in Port Wells district, 70 miles from Valdez. Last shipment made to Tacoma smeltery showed value of $140 per ton. Vein is exposed for distance of 1,500 ft. and runs from sea level to the top of the Coast Range.

YUKON GOLD (Dawson)—Has bought 3½ miles of placer ground on Greenstone creek, in the Ruby camp, and will install a dredge there soon, according to reports. Company took ground under option year ago and only recently finished prospecting it. Dredge with 3½-ft. buckets will be installed and operated by steam, as it has been found the creek is not long enough to warrant installation of all the necessary equipment for an electrical plant.

ARIZONA

Gila County

INSPIRATION (Miami)—During August mill handled 85,000 tons of ore. Made extraction of 83 per cent. against a predicted recovery of 85 per cent. when mill reaches capacity. September tonnage expected to be 125,000 tons.

CALIFORNIA

Amador County

AN IMPROVISED MILL has been constructed by Harry Troop in Pioneer district and reported to be doing good work. Mortar block size of common die is sunk in the ground 8 or 10 ft. Two pieces of timber 6x10-in. section, 10 ft. high, are bolted to two sides of the mortar block. Sides are boarded up proper height and die placed therein. Screen is fastened above die and ordinary iron fittings are used.

CLINTON (Jackson)—Six men working at this gravel mine, using water hoist to lift boulders and heavy gravel out of pit. The bar is about 100 ft. deep and produces coarse gold.

KENNEDY (Jackson)—Rolla White, underground engineer, was caught in sheave at the hoist, Aug. 28. He was coming out of shaft riding bail of skip and hoist engineer not noticing him gave him no time to get off at collar of shaft.

PRODUCE DEVELOPMENT (Ione)—Cleaning, drying and shipping kaolin and sand is in progress. When present cleanup is finished a steam drier will be installed. Company will manufacture pottery and other products. More men will be employed.

EAST EUREKA (Sutter Creek)—This mine, originally Poundstone, is reported to have been bonded to Alexander Rennie. Property is equipped with 20-stamp mill, which was built about three years ago. Mine has been idle for year or more. Preparation is being made for unwatering old shaft.

CENTRAL EUREKA (Sutter Creek)—Directors at San Francisco levied an assessment of 5c. a share. Indications on lower levels are that little more work should disclose large orebodies. During this development mill will crush ore from three lowest levels. Company employs 100 men James A. Davis is superintendent.

Butte County

WATER FOR ELECTRIC POWER amounting to 6000 in. has been applied for in Little Butte Creek by Malcolm D. W. Greene, to be applied to mining property on Magalia Ridge. It is purposed to generate 1500 hp.

Eldorado County

LARKIN (Placerville)—Suit to quiet title decided in Superior Court in favor of Charles F. Becker, who has been in possession for past five years. Property formerly controlled by Larkin Mining Co. Company trustees did not contest Becker's rights.

Inyo County

DARWIN DISTRICT has good prospect of development. Tex Hall and Frank Paul, of Ely, Nev., have 18 men employed sampling some of the mines.

ANTIMONY ORES amounting to 25 tons daily reported being shipped from Wild Rose Cañon. Ore is hauled by motor trucks to Trona, thence shipped east by rail.

CALMICH (Deadwood)—Development shaft will be sunk to 100 ft. Installation of hoist and other machinery contemplated if development should warrant.

DONNELLY GULCH (Lewiston)—New 5-stamp mill under construction at this mine near Deadwood. Property is owned by Wallick, Davis, Johnson and Blakemore, who are practical miners and mill men.

SKIDOO (Skidoo)—Preparations being made to install 44-hp. gas engine for auxiliary purposes. The 24-mile pipe line carrying water to the mill has required some repairs during hot weather. Mine in good condition.

AMERICAN (Zabriskie)—Reported that operations will be resumed by Harris, Gilbert and Baker, of Nevada and Zabriskie, who purchased property from estate of Andrew McShane, who located mine 17 years ago. Ore is said to be high grade.

McCAUSLAND (Zabriskie)—Increase in milling capacity from 40-ton Lane mill to 150 tons is contemplated. Series of veins from 2 to 6 ft. in width carries ore running from $12 to $200 per ton. Mill is operated below sea level. Ross D. McCausland is superintendent.

BISHOP CREEK (Bishop)—Ore averaging $13 per ton is being crushed, with approximate recovery of 84%. Installation of slimes table for making closer recovery is contemplated. Ledge shows average width of 17 ft. Low-grade ore running $7 per ton is held in reserve.

IBEX (Zabriskie)—Lead and zinc ore being extracted and shipped on burros 15 miles to Tonopah & Tidewater R.R. Lead ore is said to run about 38% lead and the zinc ore 68% zinc. Veins are parallel and ore comes from depth not greater than 75 ft. Twenty men are employed.

PAMLICO PLACER (Bishop)—Placers in Hawthorne district formerly owned by Burns, Blackburn & Schumaker taken over upon payment of $2,000 cash on purchase price of $20,000. Stated that gravel contains about $4 per yard. Company organized by Senator Key Pittman and H. S. Brady, of Nevada.

CERRO GORDO MINES (Keeler)—Lease held by Louis D. Gordon expired Sept. 18. Property taken over by company without change in operation, and with Mr. Gordon as manager. Production of zinc in August was 1,620 tons. In first half of September, or to Sept. 18, estimate is 1,200 tons of zinc and 200 tons of lead. Tramway from mine to Keeler is completed and handling 100 tons of ore per day. Company employs 150 men.

Madera County

DAULTON (Madera)—Copper ore that has lain on dump for several years will be treated in old smeltery which has been out of commission for 13 years. J. P. Pennell, of Fresno. has leased property from Walter Smith, of Madera. Leaching plant has been installed to treat 2,000 tons of sulphide ore.

Nevada County

MEADOW LAKE DISTRICT is becoming active. Mrs. Tolo Wyment has given bond on her property where number of men are improving road over mine to lake. John C. Clark is rebuilding road from Meadow Lake to Three John mine. Good strike of ore was recently made at Gold Dollar mine, which has encouraged new development.

NEVADA COUNTY MINES CO. (Grass Valley)—Company has taken over Union Mine on Banner Mountain. D. W. Shanks, formerly superintendent of Union Hill Gravel Mines in Trinity County and J. Nelson Nevius, mining engineer of Los Angeles, are organizers of company. Unwatering of 225-ft. shaft will begin immediately. Gasoline engine used to operate pump. Mine was an early-day producer.

Placer County

DREDGING ON BEAR RIVER below Dog Bar Bridge will be undertaken by Thomas Donahue and associates, of Seattle. Understood that California type bucket-elevator dredge will be installed, to cost $75,000.

HERMAIN (Westville)—Operation resumed and 10-stamp mill in commission. Large amount of supplies being taken in for winter which begins early; heavy snows prevent packing during that season.

Plumas County

ROBINSON (Quincy)—Posey and Miller, representing Colorado men, have taken bond on this quartz mine in Graham basin. Installation of roller mill is contemplated. It is also intended to build 6-mile road from basin to Junction House on Oroville road.

Siskiyou County

CHROME DEPOSITS at Dunsmuir recently purchased by Clarence M. Oddie, have been sufficiently developed to supply limited quantity of ore. Property was old producer, but is so situated that it cannot be economically worked in winter months.

HEAD WATER (Yreka)—J. E. McBride, of New York, who became interested in this property on north fork of Humbug Creek 16 years ago, recently made business visit and prepared for sinking shaft on ledge, which has been developed by assessment work.

DAVIS CONSOLIDATED (Happy Camp)—Property closed down for season on August 25, having had an average quantity of water. Before resuming operations on Nov. 1, sawmill 9 miles distant from mine will be overhauled and a supply of lumber cut. Main 30-in. pipe line on bedrock will be extended west 400 ft.; 1,100 ft. of 22-in. pipe and two 300-ft. strings of 15-in. feeder pipe will be entirely relaid.

Shasta County

NOBLE ELECTRIC STEEL CO. (Heroult)—Second furnace blown in working on chrome ore mined at Lowery, Tehama County. Since resumption of operation company has

manufactured 600,000 lb. of ferromanganese. Fifteen carloads have been shipped to Eastern points in Illinois, West Virginia and Pennsylvania. Eighty-five men are employed. J. J. Cogan is superintendent.

Tuolumne County

CHILANO (Jamestown)—Charles Gillis, owner, reported to have interested men in this property which will be reopened.

RAWHIDE (Jamestown)—Reported that negotiations are in progress for purchase of this property by Nevada men. Rawhide was one of important mines operated by Captain Neville during his prosperous days of Mother Lode mining.

Yuba County

MOTHER LODE MINING CO. (Marysville)—Superior Court has made restraining order prohibiting the company from working property in Indiana Ranch district claimed by Red Ravine Mining Co.

COLORADO

Boulder County

AMERICAN (Gold Hill)—Is erecting 50-ton amalgamation mill below and adjacent to outcrops of numerous closely spaced, nearly vertical veins. Extensive prospecting by trenches, cuts and adits has proved wide belt of thoroughly oxidized siliceous free-milling material, worth about $4 per ton and which, it is believed, can be mined and treated for about $1.30 per ton. James H. Caldwell, of Denver, is president and manager.

Clear Creek County

COMMONWEALTH (Georgetown)—Imperial Mining Co. shipped lot running 2.74 oz. gold, 60 oz. silver, 22% lead and 9% copper.

NORMAN (Silver Plume)—Mine dump is being sorted and shipped by Lampshire & Co. to Mendota mill, where it is converted into good lead-silver concentrates.

CAPITAL (Georgetown)—Bruce & Co. and Hummer & Son are taking out very good gold-silver-lead ore. Mill is kept busy on ores produced by company and leasers.

MENDOTA (Silver Plume)—Chappell and Lyon make monthly shipments of lead-silver-gold ore worth about $60 per ton. Stephen Bros. are mining narrow vein of lead-zinc ore.

Gilpin County

GILPIN-EUREKA (Central City)—From 30 cords of ore mined by McCallister & Co. on 600 level, mill recovered retort weighing 54 oz., worth nearly $800.

INGALLS (Central City)—Leasing company has settled for 8 tons high-grade smelting ore at 5.20 oz. gold, 27.9 oz. silver and 5.65% copper, worth net about $115 per ton.

GILPIN-ORION (Central City)—Leasers' last shipment from 2-ft. vein—11 tons—was to Globe smeltery, Denver, and gave returns of 7.46 oz. gold, 10.0 oz. silver and 2.4% copper.

FRONTENAC (Russell Gulch)—Six sets of leasers are working in levels 5, 6, 7 and 8 and, during August, shipped 94 tramway carloads to Iron City mill, in addition to 2 railroad carloads of smelting ore sent to Denver.

BATES (Black Hawk)—Leasing company shipped to Denver for smelting 18 tons of ore running 1.16 oz. gold, 10.25 oz. silver and 1.7% copper. Carload lot of concentrate shipped to same works ran 0.87 oz. gold and 3.08 oz. silver.

OLD TOWN (Russell Gulch)—Hutchens lease shipped 24 carloads via Gilpin County tramway to Iron City mill, Black Hawk, and recovered retort weighing 24 oz. and 20 tons of concentrate assaying 1.90 oz. gold and 2.0 oz. silver. Tramway cars average about 8 to 10 tons of sulphide ore, their capacity being each one cord, the county's unit of measurement for mill ore.

COEUR D'ALENE (Central City)—William F. Gray, superintendent, states that most of his work done this summer in reopening this old property has been in main shaft and in levels 6 and 7. Five raises have been made to block ore and another crosscut is being driven to catch vein. Breast of 700 level shows 4 ft. of mill dirt that is shipped to and treated in Buell mill, near Black Hawk.

PEWABIC (Russell Gulch)—All property of Pewabic Consolidated Mines Co. has been sold at auction by trustee of United States court of bankruptcy. Representing Eastern capitalists, William F. Gray secured entire holdings for $30,-500; a figure below value of machinery and buildings on mine. He thus acquired 25 unpatented and 11 patented claims, all buildings and machinery. This mine, adjacent to Old Town mine, was formerly active and prosperous.

PITTSBURGH (Russell Gulch)—Manager Auger makes shipments punctually every month, always marketing products in several lots representing different working faces. The five lots for August were not so large as usual. They varied in tonnage from 8 to 16 tons each and were settled at following minimum and maximum assays: Gold, 4.18 oz.—9.49 oz.; silver, 6.75 oz.—12.0 oz.; copper, 6.1%—17.2%. Three cords put through U. P. R. mill, Central City, yielded retort weighing over 7 oz. and 8 tons of concentrates running 1.85 oz. gold and 5.0 oz. silver. Eight cords treated in Iron City mill returned 15-oz. retort and 2 carloads of concentrates running 1.16 oz. gold and 5.17 oz. silver.

Lake County

EVENING STAR (Leadville)—Entire surface plant at No. 5 shaft was destroyed by fire that broke out in middle of night, entailing loss estimated at $10,000. George E. Cramer, leasing mine, believes fire of incendiary origin, similar fire having destroyed plant here almost exactly year ago.

AMERICAN SMELTING & REFINING CO. (Leadville)—Legal controversy instituted by this company against the county commissioners relative to tax assessment has occupied several weeks of attention of Judge Cavender. County assessor McDonald had assessed Arkansas Valley smelting plant at a valuation of $503,090. Company sought a reduction of $147,000. Court decreed that assessment must be lowered $74,510 and that county must refund to smelting company tax already paid on this amount, together with interest on same. After this decision, company, through its tax agent, A. B. Teal, submitted petition to commissioners requesting reduction in assessment on its property listed as "stocks and securities," which are represented as worth $173,600. Warm arguments followed in which county officers made new demand for examination of the company's books, demand previously denied and again denied at this time.

HILL TOP (Leadville)—This mine is almost on ridge of Mosquito range, on opposite side from its headquarters. About 50 men are employed developing and mining good tonnage of lead-zinc-silver ore that is shipped via South Park branch of the C. & S. Ry. Owing to high altitude with adverse climatic conditions and to somewhat heavy water handicap, property remained idle for two years until George B. Berger and associates of Denver resumed operations last spring, when prices for zinc became attractive.

San Miguel County

COLORADO MANGANESE (Norwood)—Has shipped five 25-ton carloads of rich manganese ore that is sold to chemical trade. It runs but 0.43% iron and sells for $65 per ton, f.o.b. cars Placerville.

Summit County

KING SOLOMON (Breckenridge)—Daniel Davidson, et al, leasers, have vein 6 to 40 in. thick from which they have shipped 11 carload lots running about $40 per ton in gold and lead.

MONTEZUMA MINES & MILLING CO. (Montezuma)—This company, with the technical guidance of James M. McClave, of Denver, has made extensive flotation tests on the complex ores of this abandoned district and has remodeled mill (erected two years ago to operate by dry concentration) into flotation plant. Silver Wave mine has been provided with an aërial tram 6,880 ft. long to this mill, and machinery is being placed on Silver Princess mine. With recent demonstration on large scale of success of oil flotation on these ores, this region has taken on real activity after almost complete idleness for nearly 30 years. Originally this district was prosperous while mining lead-carbonate ores rich in silver and gold. When sulphides of lead, iron, copper and zinc were encountered, they were accompanied by gangue of baryta that precluded clean separation by gravity methods of that time.

IDAHO

Shoshone County

CONSTITUTION (Kellogg)—This Pine Creek property has shipped two cars of first-class zinc ore and will ship third soon.

RAY-JEFFERSON (Wallace)—According to announcement of D. C. Smith, president of the Ray-Jefferson, group of larger stockholders have subscribed loan of $200,000 for further developing mine and building mill.

SUCCESS (Wallace)—This company has announced monthly dividend of 6c. per share, payable Sept. 23, and amounting to $90,000. Product mainly zinc with a little lead. Parallel oreshoot has recently been discovered which have been proved from 500 to 900 level and which may duplicate one now being mined.

MARK COONEY (Burke)—Old Mark Cooney property near Burke, consisting of four claims and three fractions, all patented, has been sold to W. M. Neary, of Spokane, for $150,-000, of which $25,000 was paid in cash. There are three tunnels, each about 200 ft. long. As soon as machinery and other equipment can be landed, the new owners will start driving 500-ft. crosscut to develop vein at greater depth.

IDORA (Wallace)—Option on this property held by P. J. Dwyer, of Missoula, Mont., for $150,000, expired on Sept. 15. Company plans further development under management of C. E. Mallette, of Spokane. Company owns 100-ton mill on Beaver Creek, now under lease to Tuscumbia with provision to treat Idora ore when desired.

KILL BUCK (Wallace)—This property, owned by ex-Senator Clark, of Montana, is to be developed at once by extending Vulcan tunnel, which will explore Kill Buck 900 ft. below present workings. Considerable ore shipped from Kill Buck in early days. Claims patented and property long been idle. Located mile and half west of Wallace, on Lake Gulch. Vulcan tunnel one-half mile further west and near railroad.

CHICAGO-BOSTON (Wallace)—Announced this week that parallel vein had been found on Chicago-Boston ground and crosscut at depth of 125 ft. shows 12 ft. commercial lead-silver ore, with considerable clean shipping grade. Ore in original vein is gray copper running high in silver. Property is on Lake Gulch, adjoining Kill Buck on east and second vein is supposed to be identical with Kill Buck vein. Report that properties will be consolidated and developed through Vulcan tunnel.

REX (Wallace)—M. J. Sweeny, manager of the Rex Consolidated company, which recently took bond on Rex mine, states that restoration of plant which was partially destroyed by fire recently will be completed about Sept. 20, when unwatering mine will be begun, which will probably require 30 days. Property is under bond for $200,000, payable in five years, or $150,000, payable within one year. Recent information is to effect that company is preparing to pay for it on last-named terms.

HYPOTHEEK (Kellogg)—Drifting from 1,100 level to vein, approximately 160 ft. Probably cut vein in less than a week. Encountered stringer of clean galena a foot thick, and numerous other stringers of quartz with more or less ore. Oreshoot down to 900 level almost all carbonate, and management hopes to find shoot changed to galena on 1,100. Occurrence of carbonate at that depth unknown in any other mine of district. Company shipped first car of crude ore this week. Plans being prepared for mill.

MICHIGAN

Copper

MASS (Mass City)—Production, including unusually large amount of barrel and mass stuff that goes directly to smeltery, now keeps one of furnaces at Quincy smelting plant in operation almost continuously.

ALGOMAH (Houghton)—Has resumed sinking from third level. This was not accomplished without considerable difficulty. Unwatering was troublesome and then it was necessary to lay skip road to third level, nearly 100 ft.

HANCOCK (Hancock)—Opening of No. 7 shaft, which is to be worked jointly by Quincy and Hancock companies, will be in shape to figure on actual mining of rock by Oct. 1. Repair crew going through shaft expects to reach bottom before that date. Quincy company will, of course, be able to commence hoisting rock soon after for reason that it has its old workings at depth and it will need comparatively little cleaning up to get into vein rock. On the other hand Hancock will have to do certain amount of underground exploration work to develop mineral on its property immediately adjoining.

TREMONT-DEVON (Hancock)—Diamond-drilling work on property in Ontonagon may be resumed within a month. Officials of company have such plans under consideration but as yet no definite decision has been reached. Lands comprise 680 acres. Desultory work was done on property before combination of two organizations as now in effect. Present company purposes to drill land thoroughly and in addition to open further some of pits sunk in early days when rock running more than 25 lb. refined copper was extracted. Land is in vicinity of Victoria, apparently in line of Keweenawan formation. Charles Smith is president; F. H. Begole, vice-president; and C. H. Hanchette, secretary and treasurer.

FRANKLIN (Houghton)—Conglomerate rock is making best showing of anything that ever has been taken out of this mine. In the 33rd stope, rock is averaging above 40 lb. copper. This is such unusual showing that miners are enthusiastic about it. Indicative of assurances for the future of this Allouez conglomerate on Franklin property, it might be stated that company has drills at work on 11 levels and on 10 of these are in good average commercial rock. Last week shipments of rock to mill showed substantial increase in amount of Allouez conglomerate and consequent decrease in amygdaloid. Change resulted in mill return of unrefined copper that was particularly satisfactory and better than anything in recent past. Mine is making money on its present tonnage; has sufficient reserves to maintain tonnage or increase it; and Franklin has best chance of its life to become profitable producer.

QUINCY (Hancock)—Is continuing to maintain daily rock tonnage of 4,000 tons. Average copper content is little better than average for recent years. Mesnard shaft showing is improving in most northerly openings which is further assurance relative to rock in newer Pontiac shaft, which was closed down when strike of 1913 began and has never been reopened. It has been rumored at various times that this shaft would be reopened. As matter of fact it was well opened underground, some connections with Mesnard were made and depth continued to practically capacity of temporary hoist. Foundations for permanent hoist and compressor plant were put in before strike. Some of machinery had arrived, but no construction work was attempted, presumably because it was realized that this work must necessarily be expensive and with no immediate return in copper. Quincy management desires first of all to build up its surplus to its accustomed strength and maintain its dividend at same time.

Iron

CRYSTAL FALLS—The operators in this district have granted increase in wages of 10%. This will place wage scale back where it was prior to last fall.

PEWABIC (Iron Mountain)—Hoisting and shipping now being done from four shafts. One shovel loading from stock. Walpole again in operation. More men added to the pay roll.

BATES (Iron River)—Became shipper last week for first time this season. Stock of 40,000 tons will be loaded and shipped. The work of putting down the shaft deeper is completed. Great deal of development work is being carried on underground. Mine is just getting good start and will be larger producer in 1916.

BRISTOL (Crystal Falls)—Contract let to Hicks & Barber to change course of Brier Hill Creek and clear large piece of ground. New orebody has been found underneath. Water would be hindrance to underground operations. Sinking operations will start as soon as contract is completed. Two four-compartment shafts will be sunk 300 ft. Ore deposit was located by drills.

WAKEFIELD (Wakefield)—Ore sales from here this year amount to 625,000 tons. Three shovels and five locomotives are kept busy in pit. One shovel is stripping and two loading. Stripping will be continued all winter. Mine will probably be called upon to deliver large tonnage next year. Shipments are averaging 5,000 tons daily and will continue at that rate until close of navigation.

MINNESOTA

Cuyuna Range.

ADAMS (Oreland)—Mine will be unwatered immediately upon receipt of electrical pumping equipment now ordered.

IRON MOUNTAIN (Manganese)—Company has sold 8,000 tons of manganiferous material to Pittsburgh Steel Co., and tonnage is going forward at rate of 4 or 5 cars daily.

ONAHMAN IRON CO. (Crosby)—This company, heretofore operating on Vermilion Range, has closed deal for Duluth-Brainerd mine in manganiferous belt of the Cuyuna district. Mine has been renamed "Ferro." Property is served by Northern Pacific Ry. and has complete surface equipment although but little underground work has been done.

Mesabi Range

LA RUE (Nashwauk)—Mine will start shipping after long idleness.

MAHONING (Hibbing)—Ore shipments are averaging 450 cars per day. Mine will be one of heaviest Mesabi shippers this season.

HULL-RUST (Hibbing)—This property is sending out about 700 carloads per day. Cars average 45 tons each. Missabe road is handling about 1,500 cars daily from Hibbing district.

CHISHOLM—Shovels are working off and on at Clark, Glen, Chisholm and Myers properties. Most of ore in stock has been moved. All of ore that is hoisted is going forward to docks.

DUNWOODIE (Chisholm)—Winston-Dear Co. has about completed its contract here for Arthur Mining Co. Two shovels will be removed from pit next week. Arthur Mining Co. has one shovel at work now, stripping for permanent approach.

SECTION 27 (Chisholm)—First shipment of ore was made from here last week. It consisted of 11 cars. Underground work is progressing slowly. It was not thought when shaft work was started some months ago that any shipments would be made this year.

LEONARD-BURT (Chisholm)—One shovel is now working two shifts loading ore. Another is loading rock that is being used to make stocking ground at Section 27 property. It is necessary to remove rock and lean ore in order to get at better-grade ores farther on.

QUINN-HARRISON (Nashwauk)—One unit of washing plant now operating declared to be successful. At full capacity plant will handle 8,000 tons of ore per day. It is third washing plant to be erected on Mesabi range. One now under construction at Crosby mine, Nashwauk, will be working next month.

SHENANGO FURNACE (Chisholm)—Notice has been given to 40 house owners to remove their property from company's forty directly north of Monroe mine. Land is to be stripped this winter. Most of structures are merely shacks but some are fairly respectable dwellings. Large deposit of ore is known to exist on this forty.

BUTLER BROS. (Nashwauk)—New type of steam shovel has arrived for this firm. It is now being assembled. It will be used in stripping Mace No. 2 mine. It weighs 315 tons. It is similar in some respects to shovels used in coal fields in Kansas. Dipper has capacity of six yards. Dipper stick in transit occupied two flat cars. Boiler is elevated 25 ft. Shovel has circular base and swings on roller bearings; can be worked from any position.

MISSOURI, OKLAHOMA AND KANSAS

FAIRCHILD AND MATHIAS (Joplin, Mo.)—Will drain their lease on Rex land; are installing an Emerson pump, which will drain ground to 130-ft. level.

BIG SQUAW (Lincolnville, Okla.)—Will rebuild mill at old mine; most of machinery which has been removed will be replaced with new; work will be conducted at 140 level.

OWASSA (Duenweg, Mo.)—Is to build new mill of 250 tons capacity on its lease on Mercantile land south of Duenweg. Plant will be equipped with two sludge tables, and air compressor. Will install gas engines for power.

CHAS. EARKHEART (Galena, Kan.)—Is to build large plant, to handle tailings only from Squires mill; will have novel system of roughing, cleaning and finishing tables, and will be operated by gas engines. Mill will handle 400 tons every 10-hr. shift.

GALENA ROYALTY & MINING (Galena, Kan.)—Has struck another good prospect in drilling on one of leases south of Galena. Company has several hundred acres leased for mining purposes, it drills and prospects land and leases it out to mine operators to develop and mine on royalty. Have 40 acres already drilled and leased out.

MONTANA

Silver Bow County

BUTTE & LONDON (Butte)—Unwatering of the Butte & London shaft was completed Sept. 11 and sinking was started Sept. 13. New electric pump has been installed at the 1,100 station and small pump at 800 has been disconnected. It is expected to make 10 ft. per day in sinking and that 1,600-ft. point will be reached in November, when station will be put in and work of crosscutting property both north and south will be started.

BULLWHACKER (Butte)—Has again been shut down, and negotiations are on for resumption of operations with leaching plant, which was installed some years ago. Experts who have examined plant claim that with few changes plant can be made to work successfully. With completion of acid-producing plant at Washoe smeltery it will be possible to purchase acid for leaching purposes at less than half what it formerly cost Bullwhacker and Butte Duluth companies.

NORTH BUTTE (Butte)—The output is now in excess of 2,000,000 lb. of copper per month, and from present indications the output for the year will far exceed that of 1914, when the total production was 18,421,761 lb. of copper, 1,092,300 oz. of silver and 1,107 oz. of gold. While production during first months of present year was only about 50% of normal, it has been steadily increasing until at present time it is close to capacity of the mine. Between 750 and 800 men are employed as against less than 500 six months ago. Daily tonnage is about 1,200 tons and from this about 80,000 lb. of copper is recovered. New Granite Mountain electric hoist is working splendidly and has enabled North Butte company to make a big reduction in cost of production. Production is not yet back to the average of 1913, when ore hoisted averaged 1,342 tons per day and more than 28,000,000 lb. of copper was produced for year. At that time average number of men employed was 800.

BARNES-KING (Butte)—Is still negotiating with Kendall company for settlement of disputed orebody in North Moccasin ground, from which Barnes-King has been mining for long time, but no settlement has yet been reached. Idea of purchasing all of the Kendall company's holdings has been abandoned because of excessive price placed on its property. While controversy exists Barnes-King company has stopped operations in all disputed ground, although greater part of orebody is recognized as belonging to Barnes-King company. As consequence of dispute August output of North Moccasin mine dropped to $14,500, whereas former months yielded

about $32,000 in bullion. Only 1,464 tons of ore were mined in August from the North Moccasin mine against former average production of about 5,000 tons per month. At Piegan-Gloster property, in Marysville district, considerable improvement is noted. The receipts from the mill were $16,000 from 1,800 tons of ore. Tonnage is still far below the capacity of mill. Good progress is being made in developing the Shannon property, and showing in shaft being sunk from tunnel level is so good that company, it is understood, is seeking to acquire some more property adjoining Shannon.

BUTTE & SUPERIOR (Butte)—Blackrock mine of Butte & Superior company was closed for four days last week 'o permit of some needed repairs and suspension will probably result in decrease in September spelter output of company. It had been more than year since last repairs were made in shaft and some trouble was experienced recently. Mine had been run at capacity for many months and no opportunity given to make needed repairs so that it became necessary to close mine for several days, which was done when Labor Day holiday came around. With repairs just completed company will make another long run. Production of spelter last month was about 14,500,000 lb., or nearly 1,000,000 lb. in excess of any previous month. This big output was made in spite of fact that tonnage of approximately 45,000 tons of ore mined and milled was not up to July tonnage. "The improvement in the recoveries and grade of concentrates was brought about largely through the greater efficiency of the new machines," says Manager J. L. Bruce. "The adjustments are better in the flotation plant now and the results are showing what improvements have been made recently." Recoveries averaged 93%, while the grade of concentrates was 56% against 51% in former months. In regard to report that large body of copper glance has been found in Black Rock mine, Mr. Bruce said: "There is no truth in that report. Such reports have been circulated from time to time, but there is little or no foundation for them. Once in a while a body of copper glance will be run into in certain parts of the mine, but there is no evidence that our zinc ores are giving way to copper in the districts where we are mining." The same is true about reports that an unusual strike of zinc ore had been made. Nothing new has been found. By an order of district court few days ago $1,000,000 mortgage on Butte & Superior property was cancelled, mortgage having been satisfied by exchange of bonds for stock in company. Shaft sinking is going on in the Black Rock shaft, which has now reached depth of 1,750 ft. and station is being cut at 1,700 ft.

SOUTH DAKOTA

Custer County

FAIRVIEW MICA (Custer)—Property has been purchased by Salt Lake parties, who have commenced operations.

Lawrence County

TROJAN (Trojan)—Equipment for fine grinding will be installed at early date.

WASP NO. 2 (Flatiron)—Production of wolframite continues; recent shipments were sold for $15 per unit of tungstic acid. Mill is operating steadily on maximum tonnage—500 daily—of $2 gold ore.

ECHO (Maitland)—Small boiler is being installed to furnish steam for sinking pump. Shaft, 175 ft. deep, will be continued to 200 ft., station and sump cut at that point, and extensive lateral work done. Station pump will be electrically driven.

RATTLESNAKE JACK (Galena)—Milling has been suspended until arrangements can be made to dispose of tailing in some other way than running into creek. An Oliver filter has been ordered, with intention of using it as dewaterer before stacking tailing. Plant is fine grinding with cyanidation by Trent process.

Pennington County

HOME LODE (Silver City)—Company is operating plant of 25 tons daily capacity, treating ore containing free gold, jamesonite, pyrite, and some lead and copper. Fine grinding in slow-speed Lane mill is making large percentage of the gold amenable to amalgamation. Good separation of antimony mineral is made on Deister tables. Further concentrating equipment is to be installed at once.

UTAH

Beaver County

PALOMA GOLD & SILVER (Milford)—Company has made a trial shipment of copper ore that averaged 18% Cu, and 11 oz. Ag. A recent silver-lead shipment ran 22% Pb., 17 oz. Ag., and 2% Cu. Shaft will be deepened to 500 ft. Compressor and drills being installed.

Juab County

BECK TUNNEL (Silver City)—Drifting is being done south on 1,100 level, with view to prospecting ground, on which only small amount of work has been done.

TINTIC (Silver City)—Work on company's mill is progressing satisfactorily, and it is expected that operation will begin Jan. 1, with an initial capacity of 200 tons daily. Ore from Knight and Dern properties will be treated.

SCOTIA (Eureka)—About 1,000 tons of lead ore have been hoisted, and as soon as new traction engine—expected at mine soon—has been put in operation, about 23 tons of ore daily will be hauled to railroad at Jericho, 18 miles from property.

YANKEE (Eureka)—Recent strike near surface is opening up satisfactorily. Shaft has been sunk 60 ft. from surface, 40 ft. of this being in ore. Raise is being sent up from lower tunnel to connect with it. Drifting will be undertaken later.

UTAH MINERALS CONCENTRATING (Eureka)—It is stated that this company, which has been doing experimental work on low-grade ores from Chief Consolidated is preparing to start active operation. Other ores beside those of Chief will probably be treated.

Salt Lake County

MICHIGAN-UTAH (Alta)—It is announced that this company has been financed for active development work, to be started in near future. Shipments are being made from Grizzley workings by leasers, whose lease expires Oct. 7. After that date work in this section will be taken over by company. City Rocks vein above Cleaves tunnel is being worked by Triangle Mining Co., employing 30 to 40 men.

ALBION (Alta)—Large flow of water has been tapped recently in Albion drift being driven from Quincy tunnel of South Hecla. This has prevented Albion miners and leasers on Kate Hayes fissure from going to work. Flow was knee deep in Quincy and on Sept. 13 was estimated at 5,000 gal. a minute. Carbon-dioxide gas accompanied or followed the flow and two men equipped with oxygen helmets went into drift to do some work on air line. Both were overcome by gas, the helmets evidently not working properly. One was rescued but other, James Hendrickson, was found dead day following.

Tooele County

THE DRY CANON DISTRICT is active. Other properties producing are Wandering Jew, from which a car was shipped recently, and the Hidden Treasure, where a considerable force is working.

QUEEN OF THE HILLS (Stockton)—Carbonate zinc ore of good grade is being produced from this property, under lease to Big Four Exploration Co.

MONO DEVELOPMENT (Stockton)—Leasers are mining silver-lead ore, and as soon as installation of new compressor has been completed, production will be increased.

CANADA

British Columbia

FRENCH ZINC PROCESS—The provincial government has promised to aid financially in the providing of an experimental plant to further demonstrate this electro-chemical process.

BLUE GROUSE (Vancouver Island)—Six men are engaged in driving tunnel on recent discovery, which is situated near Cowichan Lake. An oreshoot 300 ft. in length has been exposed by surface stripping, varying in width from 15 to 36 ft. and averaging between 4 and 5% copper.

DELLA (Vancouver Island)—An electric hoist is being installed by Pennsylvania people who have this property under bond. Group is located 11 miles from Great Central Lake, in interior of island. Sinking is proceeding by two shifts on quartz vein 6 ft. wide that outcrops for a length of 2,000 ft. Gold occurs in ore in association with zinc blende.

Ontario

McINTYRE (Porcupine)—On 600 level has cut 6-ft. vein assaying $30 per ton.

SHAMROCK (Cobalt)—Mine has been unwatered and crosscutting started on 400 level.

HOLLINGER RESERVE (Porcupine)—Dominion Reduction Co. has dropped its option on this property.

DOBIE (Munro Township)—Vein, which was 1 ft. wide at depth of 11 ft., has widened to 3 ft. at 100-ft. level.

DOME (Porcupine)—Will add new equipment to mill that will bring capacity up to 50,000 tons per month.

BUFFALO (Cobalt)—Mill has closed down, but development work is being continued.

HOLLINGER (Porcupine)—In sinking new main five-compartment working shaft a new vein has been cut, which shows 10 ft. of $8 ore.

DOMINION REDUCTION (Cobalt)—Has taken an option on 400 acres, including 8 Bowser claims and 2 Brennan claims in Goodfish district.

CREIGHTON (Sudbury)—Made record production in August when it hoisted 73,000 tons. At Crean Hill and No. 2 mines 17,000 tons were raised, giving total production for the month of 90,000 tons. New five-compartment shaft at Creighton, 32x8 ft., was sunk 135 ft. in granite during July.

TOUGH OAKES (Kirkland Lake)—Has been temporarily closed down, owing to shortage of electric power. Winze has been completed to 400 level and is in rich ore, 5 ft. in width, averaging $70 per ton.

KING DODDS CLAIMS (Kowkash)—These three claims, on one of which original Kowkash discovery was made, have been taken over on working option by syndicate of American and Canadian capitalists, headed by John L. Orn, of Buffalo, and C. M. Forbes, of Lanark, Ont.

NIPISSING (Cobalt)—During August estimated value of ore mined was $179,048, and bullion from Nipissing and customs ore estimated value of $118,047 was shipped. Arrangement has been made with O'Brien company to coöperate in development of adjoining territory.

BEAVER (Cobalt)—Report for quarter ending Aug. 31 states that main shaft is down 1,100 ft. and that sinking will be continued until lower contact between diabase and Keewatin is reached. Promising orebody was encountered in drifting on 300-ft. level. There was $116,017 cash on hand and bullion and ore amounting to 314,511 oz.

TECK HUGHES (Kirkland Lake)—At annual meeting formally turned over property to Buffalo Mines of Cobalt, which has purchased outright two-thirds interest. Working capital for further development and for building mill, will be supplied by bond issue of $150,000, which will be taken up by Buffalo. Mine has $350,000 worth of ore developed.

Quebec

EUSTIS (Sherbrooke)—Fire has totally destroyed mill. Loss, $50,000.

The Market Report

Metal Markets

NEW YORK—Sept. 22

The copper market was fairly active and advanced slightly. The markets for lead and zinc were dull, but toward the end of our week of record exhibited a stronger tone. Tin was stationary, almost no business being done.

Copper, Tin, Lead and Zinc

Copper—At the beginning of our week of record copper was freely available from first hands at 17¾c., regular terms, corresponding with 17.55c., cash, New York. All of the American producers offered freely in Europe at £86, and made sales at that figure. What such sales would realize in cash in New York was problematical, depending on the rate of exchange and the freight rate, both of which are very uncertain factors at present. Some producers have old contracts for freight which enable them to send copper abroad for c.i.f. charges of about 40c. per 100 lb., while others have to reckon 50@60c., freight alone being 30@40c. at current rates. Probably about 17.45c., New York, was the mean equivalent of £86. On Sept. 20 the market abroad improved materially, and £86½@86¾ was realized on export sales, and on Sept. 21 and 22 business was done at £87. The price asked of domestic consumers was 18c., regular terms, right along by the principal producers. Other producers who had previously been offering at 17¾c. raised their asking price to 17⅞c. on Sept. 20. Domestic consumers were, however, conspicuous by their absence up to Sept. 22, when one of the wire drawers contracted for a round lot. For this order there was sharp competition.

A fairly large business was done during the week, the aggregate being estimated at somewhere between 20 and 35 million pounds. This was almost entirely for foreign account, France especially being a large buyer, while Great Britain and Russia took smaller quantities. The demand was chiefly for immediate delivery, out of warehouse on the other side if possible, otherwise for prompt shipment from here. Domestic consumers appear to be acting in concert in staying out of the market, a feature of their policy that is becoming increasingly prominent. The natural result is that when they make up their minds to buy they have to do it all together and produce a sharp advance on themselves. It is believed among producers that the domestic manufacturers of copper goods are bound to cover large requirements for copper during the last quarter of the year.

The matter of freight rates and freight space for shipments of metal from the United States to European ports is causing a good deal of concern among shippers.

Copper Sheets are quoted about 23c. per lb. for hot rolled and 24c. for cold rolled, with usual extras. Wire prices are unsettled; quotations may be put at 19½c. per lb. at mill. The chief maker does not quote base price.

Copper Exports from the United States, week ended Sept. 4, are reported by the Department of Commerce at 4,003,092 lb., the chief items being 1,782,452 lb. to France and 1,343,162 lb. to Great Britain. Imports for the week were 2,751,200 lb. metal and 1,433,955 lb. in ore and matte; 4,185,155 lb. in all, chiefly from Canada, Cuba and Chile.

Visible Stocks of Copper in Europe on Sept. 15 were: Great Britain, 22,350; France, 5,177; afloat from Chile, 2,675; afloat from Australia, 2,550; total, 32,152 long tons, or 72,020,480 lb. This is a decrease of 1,962 tons from the Sept. 1 report.

Tin—This market was dull and about stationary, almost no business at all being done. At the close there was a rather weaker tone, reflecting the decline in London.

Production of Banka tin in June is reported at 16,111 pikuls. Stocks of Banka tin on Aug. 31 were 905 tons. Stocks of Billiton tin at same date were 30 tons.

Lead—At the beginning of our week of record there was a little wavering of the price, some sales of domestic lead for export being made at a little below the price of the A. S. & R. Co. However, the market soon steadied itself and later became rather stronger, without any further advance in price, however. A large tonnage of domestic lead, destined for export, was sold in New York on Sept. 22 at the full price.

Spelter—At the beginning of our week of record, a rather large tonnage of spelter was sold, chiefly for export. After that the market became peculiar, as it has many times before in this remarkable year. Spelter for prompt and early delivery became almost unprocurable, while for the later months it was unsalable. In the latter half of the week some small sales of spelter for spot and prompt delivery were made at about 13½c., and the price for following months up to the end of the year was about ¼c. less per month. A considerable quantity of spelter was sold during the last week on long-range contracts, such as October-June, December-June, and January-March. This business was done at prices of 10@11 cents.

Zinc Sheets—Business has been more active, but with no change in prices. The base price for carload lots is $16 per 100 lb. f.o.b. Peru, Ill., less 8% discount.

DAILY PRICES OF METALS IN NEW YORK

Sept.	Sterling Exchange	Silver, Cts. per Oz.	Copper: Electrolytic, Cts. per Lb.	Tin: Spot, Cts. per Lb.	Lead: New York, Cts. per Lb.	Lead: St. Louis, Cts. per Lb.	Zinc: St. Louis, Cts. per Lb.
16	4.6800	48⅜	17.45 @17.55	33	4.45 @4.50	4.30 @4.35	12.50 @13.00
17	4.7100	48¾	17.45 @17.55	33	4.45 @4.50	4.30 @4.42½	12.50 @13.00
18	4.6850	48⅜	17.45 @17.55	33	4.50	4.35 @4.42½	12.50 @13.00
20	4.6850	48¾	17.50 @17.70	33	4.50	4.35 @4.42½	12.50 @13.00
21	4.7125	49⅜	17.50 @17.80	33	4.50	4.35 @4.42½	12.75 @13.50
22	4.4700	49¼	17.50 @17.80	32¾	4.50	4.35 @4.42½	12.75 @13.50

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.20c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are; St. Louis-New York, 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Sept.	Silver	Copper: Standard Spot	Copper: Standard 3 Mos.	Copper: Electrolytic £ per Ton	Copper: Electrolytic Cts. per Lb.	Tin: Spot	Tin: 3 Mos.	Lead: £ per Ton	Lead: Cts. per Lb.	Zinc: £ per Ton	Zinc: Cts. per Lb.
16	23 7/16	69½	70¼	86½	18.05	153¼	154	22 13/16	4.79	68½	14.29
17	23 7/16	69	70	86½	18.12	152½	153¼	22¼	4.77	66	13.91
18	23½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	23 5/16	69½	70¼	87	18.17	152¾	153¾	23	4.81	65	13.58
21	23¾	70¼	71¼	87	18.25	153	153¾	23⅛	4.87	63½	13.38
22	23¾	70⅛	71⅛	87	18.21	152	152¾	23⅜	4.90	63	13.16

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½c.

Other Metals

NEW YORK—Sept. 22

Aluminum—The market is still quite active, and supplies not large. Prices continue about the same, 45@50c. per lb. being asked for No. 1 ingots, New York. The American producer is reported willing to contract for 1916 business at lower rates, but will not confirm or deny the statement.

Antimony—The market has been quiet, with hardly more than a retail business doing. Chinese and other ordinary brands are quoted at 28@29c. per lb., while 43½@45c. is named for Cookson's. There are some large inquiries for export, but they depend upon the outcome of pending financial negotiations.

Nickel—Quotations for ordinary forms are 45@50c. per lb., according to size and terms of order. A premium of 3c. per lb. is charged for electrolytic nickel.

Quicksilver—Business has been fair and the market has been rather more active. Prices are generally steady. New York quotations are $89@90 per flask of 75 lb. San Francisco prices are reported by telegraph at $85@90 per flask. Some dealers report large sales, but others are less active. London price is unchanged at £16 10s. per flask, second hands quoting full price.

Gold, Silver and Platinum

NEW YORK—Sept. 22

Gold—More gold is reported on the way from England, the amount not being definitely stated. How much more may come depends largely upon the negotiations now in progress over credits or note issues.

Platinum—The market is quite uncertain, owing to short supplies and the cessation of imports from France and Russia. This is about the season when supplies are looked for in the jewelry trade, but none are available. Transactions have been small. Dealers are asking $50 per oz. for refined platinum and $56@57 for hard metal. The market is very uneasy, and any considerable supply from abroad would send prices down; but no such supply is expected at present.

Iridium—Like platinum, supplies are short with no increase in sight at present. Quotations are $75@80 per oz., nominally, but each transaction stands by itself. **Palladium** is also scarce and brings about $60@65 per oz., New York.

Silver has advanced in London to 23¾d., the highest point recently reached. Purchases by the United States Government have had the effect of stimulating the Continental demand, while the supplies put on the London market have been rather limited; for this reason the undertone to the market is considered good.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—Sept. 18

The base price paid this week for 60% zinc ore was $70@74 per ton; for medium grades, $65@70 per ton. The base price paid for 80% lead ore was $50 per ton.

SHIPMENTS, WEEK ENDED SEPT. 18

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	4,741,040	80,000	440,200
Year	138,642,120	4,543,160	19,640,910

Shipped during week to separating plants, 2,838,800 lb. zinc ore.

JOPLIN, MO.—Sept. 18

Blende, high price, $82.90; base per ton, 60% zinc, premium ore, $80; medium, $79@77; lower, $76@73, with a few cars at $70; calamine base, 40% zinc, $70@50; average, all grades of zinc, $77.02 per ton. Lead, high price, $55; base price, $50@55 per ton of 80% metal content; average, all grades of lead, $50.12 per ton.

SHIPMENTS, WEEK ENDED SEPT. 18

	Blende	Calamine	Lead	Values
Totals this week	9,562,290	675,750	2,107,600	$447,090
Totals this year	406,406,680	32,667,290	63,402,110	17,855,100

Blende value, the week, $372,810; 38 weeks, $15,445,070.

Calamine value, the week, $21,480; 38 weeks, $740,260.

Lead value, the week, $52,800; 38 weeks, $1,669,770.

Seven inches of rain fell in six hours, general over the entire district, Tuesday after midnight, the effect of which was slight to some, though an injury to all, and a positive blight to a number of mines, some of which were inundated. As a camp, Galena, Kansas, suffered most; Alba-Neck, Granby and Aurora seriously for several days. The result is estimated at a restriction of 15% in output. As the effect of the enormous volume of water became felt in the mines a demand increased for the ore in bin, and week-end purchases were sharply enlarged, about 6,000 tons being purchased Friday and Saturday.

Reports received in Joplin today confirm a rumor prevalent for some time that A. O. Ihlseng, of New York, would engage in the smelting of zinc ores. Mr. Ihlseng and a Mr. Johnson of California have purchased 20 acres of land at Pittsburg, have surveys under way for tracks from two railway systems, and have much of the material ordered for the four-block smelter to be erected.

Iron Trade Review

NEW YORK—Sept. 22

There has been no material change in the iron and steel markets during the week, the situation remaining about the same.

The strong demand for steel for export has kept up prices of bars and other forms. An increase in the demand for structural steel from domestic buyers has been quite in evidence. The scarcity of crude steel is also a feature of the market, and mills using purchased billets are hunting for supplies.

Pig iron has been generally strong, but without any general advance in prices. Foundries are beginning to look for first quarter iron, and basic is in demand.

PITTSBURGH—Sept. 21

With what appears to be only an ordinary flow of business, chiefly in the form of specifications on contracts, with occasional new buying, the steel mills are falling farther behind in deliveries although they are crowding for output and are shipping more steel than ever before in their history. They already have actual shipping orders entered for almost as much steel as they can make and ship the remainder of the year. It is the common statement that if there were a normally full demand for steel from domestic sources, for instance for railroad material and structural purposes, there would be an unprecedented famine in steel. Prospective railroad requirements cannot yet be estimated, but there has been an increase in railroad buying, 75,000 to 100,000 tons of rails for spring rolling having lately been put under contract, while bids are going in on at least 10,000 freight cars. Car shortages are beginning to appear in the steel industry and a general car shortage is predicted for next month as the crops come to be moved.

Steel prices continue to show an advancing tendency. Effective yesterday the American Steel & Wire Co. advanced wire products $2 a ton, the independents immediately concurring, the new prices being: Plain wire, 1.80c.; wire nails, $1.75; galvanized wire, 2.30c.; painted barb wire, 1.90c.; galvanized barb wire, 2.60c. Plain wire is now up to the maximum price since 1910. Mills have made some contracts for bars, plates and shapes for first quarter at 1.40c., but are reserved about selling even at this figure. The market for earlier delivery, at mill convenience, is strong at 1.35c. The National Tube Co. today announced the withdrawal, Sept. 30, of all special prices on oil-country goods, the demand for which is showing considerable improvement.

The Shelby Steel Tube Co. announces that it will double the finishing capacity of its seamless-tube plant at Ellwood City, Penn., adding two electrically driven piercing mills, with the necessary attendant equipment, to have an annual capacity of 60,000 tons of finished tubes, 2-in. to 8-in., at the same time building an electrically driven continuous bar mill to reduce blooms to rounds, with an annual capacity of 175,000 tons, this to replace the present mill.

Pig Iron—The market has been quiet but prices are firmly held and it is suggested that the quietness is due largely to furnaces being reserved about selling, because they expect higher prices. The stack of the Sharpsville Furnace Co. is going into blast, and Alice, Ella and Fannie, all in the Shenango Valley, are likely to blow in shortly. We quote: Bessemer, $16; basic, $15, both for early delivery; foundry and malleable, $14.50@15, gray forge, $14.25@14.75, the higher being for next year's delivery, at Valley furnaces, 95c. higher delivered Pittsburgh.

Ferromanganese—A few contracts have been entered for ferromanganese by domestic producers since their recent announcement of a price of $115. English producers continue to quote $100 on contract, delivery being very uncertain. Spot lots command $100@115 according to supplies from day to day. The consumption of 50% ferrosilicon as a scavenger, to reduce the quantity of ferromanganese needed in soft-steel making, is reported to be increasing rapidly. Prices on 50% ferrosilicon are the same as before the war, $71 in 600-ton lots, $72 in 100-ton lots and $73 in carload lots, delivered east of the Mississippi.

Steel—The market for basic openhearth billets is all of $26, Youngstown, with only occasional lots to be picked up at this figure. Bessemer could probably be had at about $1

a ton less. Pittsburgh prices are Youngstown prices plus the freight of $1.05. There is no market for sheet bars as sheet and tin mills are covered and in any event could not afford to pay the prices that would be asked. With the advance in wire products rods become quotable at $30, Pittsburgh, but it is difficult to find sellers at any price.

Exports and Imports of those iron and steel products for which tonnages are given in the reports are stated by the Department of Commerce as below for July and the seven months ended July 31, in long tons:

	July		Seven Months	
	1914	1915	1914	1915
Exports	114,790	368,893	959,825	1,676,485
Imports	24,958	20,857	167,210	124,636

Exports for the seven months show an increase of 716,660 tons, or 74.7%; while imports decreased 42,574 tons, on 25.5%. The larger items of exports in 1915 were 241,348 tons wire and wire products; 263,985 tons billets, ingots and blooms; 219,371 tons steel bars; 126,394 tons steel rails.

Exports from Baltimore for the week included 2,234,540 lb. tin plates to Glasgow. Other exports included 6,171,387 lb. bars, plates, wire rods, wire, etc. to Great Britain.

FERRO-ALLOYS

Ferromanganese is quoted at $110@112.50 per ton for domestic 80% material. **Spiegeleisen** has been sold at $27 per ton for 20%, at furnace.—**Ferrosilicon,** 50%, is quoted at $75 per ton at Pittsburgh. Bessemer ferrosilicon is from $20 per ton for 10% up to $24 for 14%, all at furnace.—**Ferrotitanium** is 8@12½c. per lb., according to size of lots and delivery.—**Ferrovanadium** is $2@2.25 per lb. of contained vanadium.—**Ferrotungsten** is quoted in London at 7s.@7s. 6d. per lb.—84@90c.—for alloy 75@80% tungsten.—**Ferromolybdenum** is quoted in London at 18s.—$4.32—per lb. for 75% alloy.

FOREIGN IRON

Pig-Iron Production in Germany in July is reported at 1,064,899 metric tons, which is 75,022 tons more than in June and 497,045 tons less than in July, 1914. For the seven months ended July 31 the production was: Foundry iron, 1,382,946; forge iron, 173,727; steel pig, 913,566; bessemer pig, 98,329; Thomas (basic) pig, 4,031,068; total, 6,599,236 metric tons, which compares with 10,850,140 tons in 1914; showing a decrease of 4,250,904 tons, or 39.2%, this year.

Pig-Iron Production in Manchuria is being pushed. The Penhsihu Mining & Colliery Co. is turning out about 130 tons a day from its blast furnace. The iron is of good quality, very low in phosphorus and sulphur. The company has contracts to furnish iron to the Osaka Iron Works in Japan and to the Japanese navy.

IRON ORE

Some more sales of Lake iron ore in the East are reported, including a large lot of silicious Marquette ore at about 7c. per unit delivered. Some other blocks of Old Range ore are reported engaged for Eastern furnaces.

There is already talk of Lake ore prices for next season, and it is expected that buying will begin early in view of the great increase of activity in the iron trade. The general expectation is that prices will be at least 50c. a ton higher than this season.

British Imports of Iron Ore, eight months ended Aug. 31 were 4,002,044 long tons in 1914, and 4,239,167 tons in 1915; an increase of 237,123 tons this year.

OTHER ORES

Tungsten Ore is still in demand and supplies are not large. A recent sale reported is of a small lot of concentrates, running about 60%, which brought $35 per unit WO_3, for spot delivery. This is a considerable advance over the latest previous sales reported.—**Molybdenite,** 80% MoS_2 is reported sold at $1.25 per lb., New York.

A cargo of **Manganese Ore** from the newly opened deposit at Brigus, Conception Bay, Newfoundland, has been shipped to Pittsburgh. Others are expected to follow.

COKE

Coke production in the Connellsville region for the past week is reported by the "Courier" at 387,703 short tons; shipments, 388,862 tons. Production of Greensburg and upper Connellsville districts, 44,978 tons.

A Cincinnati dispatch says: "The Kentucky Solvay Coke Co., Ashland, Ky., has sold to the Marting Iron & Steel Co., Ironton, Ohio, furnace coke requirements of 150,000 tons annually for five years. This sale, which is one of the largest made in the history of the pig iron market in this territory, is on a sliding-scale basis."

Connellsville—Furnace coke contracting for the first half of 1916 is still in abeyance, but buyers and sellers seem to be getting nearer together. Two or three sliding-scale contracts recently made are hardly representative of the market, and it is possible business will be done at flat prices after all. For deliveries late in the current year $2 and $2.25 have both been paid, according to quality, etc. Spot furnace coke is $1.65@1.70, and thus slightly firmer.

British Coal Production for the first half of the year is estimated by the Board of Trade as below, in long tons:

	1913	1914	1915
Coal mined	145,923,000	140,274,000	127,826,000
Coal exported	37,279,000	36,390,000	23,595,000
Steamer coal	10,087,000	10,182,000	7,400,000
Total exports	47,366,000	46,572,000	30,995,000
Balance	98,557,000	93,702,000	96,821,000

The steamer coal is fuel furnished to steamships engaged in foreign trade. The production for the second half of 1914 was 125,369,000 tons, or 2,457 tons less than in the first half of the current year.

Fuel Exports of Great Britain, eight months ended Aug. 31, in long tons:

	1914	1915	Changes
Coal	44,257,161	29,522,179	D. 14,734,982
Coke	694,061	576,218	D. 117,843
Briquettes	1,324,937	864,503	D. 460,434
Steamer coal	13,249,027	9,657,927	D. 3,591,100
Total	59,525,186	40,620,827	D. 18,904,359

The steamer coal is coal sent abroad for the use of steamships in foreign trade.

Coal Production of Austria-Hungary, years ended June 30, in metric tons:

	1913–14	1914–15	Changes
Coal	16,514,000	14,821,000	D. 1,693,000
Brown coal	26,570,000	21,685,000	D. 4,885,000
Coke made	2,615,000	1,788,000	D. 827,000
Briquettes made	431,000	448,000	I. 17,000

Of the briquettes reported last year 241,000 tons were made from brown coal, or lignite.

Chemicals

NEW YORK—Sept. 22

The general market is still rather quiet and irregular in some lines.

Arsenic—The demand is moderate and supplies are sufficient. Prices are unchanged, about $3.50 per 100 lb. for large orders, and $4 for smaller lots.

Copper Sulphate—Business has been rather quiet and sales moderate. Prices are easier, $6.75 per 100 lb. being asked for carload lots and $7 per 100 lb. for smaller parcels.

Nitrate of Soda—Business is quite active for the season. Prices are steady at 2.42½c. per lb. for spot and 2.45c. per lb. for futures.

Pyrites—Imports at Baltimore for the week included 7,628 tons pyrites from Huelva, Spain.

Chrome Ore—The chrome-ore mines in the neighborhood of Black Lake, Quebec, are being reopened and considerable shipments are being made to the United States. These mines have been closed for some time owing to the competition of ores from Turkey, Greece and Rhodesia, which had cheap water freights. The war in Turkey and the high ocean rates from South Africa have cut off those supplies.

PETROLEUM

Shipments of crude petroleum from Tampico, Mexico, to the United States in August were 1,281,593 bbl.; in addition 70,444 bbl. were shipped to the Panama Canal Zone, making a total of 1,352,037 bbl. Shipments from Tuxpam in August were 859,054 bbl., making a total of 2,211,091 bbl. for the month.

Exports of mineral oils from the United States in July were 215,595,691 gal., being 15,673,794 gal. less than in July, 1914. For the seven months ended July 31 the total exports were 1,348,173,539 gal. in 1914, and 1,286,660,756 gal. in 1915; a decrease of 61,512,783 or 4.6%, this year.

Under an imperial decree dated Aug. 18, 1915, the Austrian Government has, as from that date, taken possession of the present and future production of crude petroleum in Galicia and of all stocks of oil belonging to business organizations owned in whole or in part by citizens of countries at war with Austria-Hungary.

Assessments

Company	Delinqe	Sale	Amt.
Bonanza Con., Utah	Sept. 15	Oct. 6	$0.015
Bullion, Ida	Aug. 30	Sept. 25	0.005
Cash Boy, Nev	Sept. 29	Oct. 30	0.01
Cedar Creek, Ida	Aug. 28	Sept. 29	0.005
Columbus Ext., Utah	Oct. 10	Oct. 30	0.025
Comet, Ida	Aug. 30	Sept. 30	0.0005
Con. Virginia, Nev	Sept. 28	Oct. 19	0.05
Copper Chief, Ida	Aug. 30	Sept. 25	0.005
Diam'field Black Butte, Nev.	Oct. 4	Nov. 4	0.01
Exchequer, Nev	Oct. 4	Oct. 25	0.02
Gethin Le Roy, Utah	Sept. 25	Oct. 13	0.01
Goldstrike M. & L., Utah	Oct. 1	Oct. 20	0.01
Great Bend, Nev	Sept. 10	Oct. 10	0.01
Hancock Cons., Mich	Sept. 1		1.00
Hancock Cons., Mich	Jan. 3		1.00
Happy Day, Ida	Aug. 26	Sept. 30	0.0025
Hector, Ida	Sept. 4	Oct. 4	0.005
Hennessy-Burns, Ida	Aug. 20	Sept. 24	0.005
Idaho Los Angeles, Ida	Sept. 3	Sept. 25	0.005
Idaho Montana, Ida	Sept. 3	Sept. 25	0.001
Idaho Nevada, Ida	Sept. 7	Oct. 1	0.002
Imperial, Ida	Aug. 31	Oct. 1	0.005
Keweenaw, Mich	Sept. 1		1.00
Laclede, Ida	Sept. 3	Sept. 27	0.003
Lake Superior & West., Ariz.			0.02
LeRoy, Ida	Sept. 25	Oct. 25	0.002
Liquidator, Ida	Aug. 28	Sept. 28	0.003
Lucky-Calumet, Ida	Aug. 27	Sept. 27	0.005
M. & P. Gold, Utah	Sept. 15	Oct. 12	0.0025
Nevada Cooperative, Nev	Sept. 15	Oct. 15	0.01
Nevada-Douglas, Nev	Sept. 27	Oct. 20	0.10
New Arcadian, Mich	Dec. 1		0.50
New Baltic, Mich	Jan. 15		0.50
New Quincy, Utah	Sept. 2	Sept. 23	0.01
Northern Light, Ida	Nov. 2	Dec. 2	0.004
Old Veteran, Ida	Sept. 2	Sept. 30	0.002
Oom Paul, Ida	Aug. 28	Sept. 28	0.01
Oom Paul Con, Ida	Aug. 30	Oct. 4	0.01
Ophir, Nev	Oct. 12	Nov. 2	0.05
Phedora, Ida	Sept. 21	Oct. 21	0.0005
Phoenix, Mich	Sept. 1		1.00
Phoenix, Mich	Jan. 1		1.00
Pioche Metals, Nev	Oct. 20	Nov. 20	0.00½
Revelator, Utah	Oct. 4	Oct. 25	0.00½
Royal, Ida	Sept. 1	Oct. 1	0.001
Sandstorm Kendall, Nev	Aug. 23	Sept. 27	0.01
Selma Utah	Sept. 8	Sept. 25	0.005
Snowshoe, Ida	Aug. 26	Sept. 27	0.005
Sunset Dev., Wash	Aug. 25	Sept. 18	0.002
Syndicate, Utah	Sept. 11	Oct. 2	0.001
Tonopah Bonanza, Nev	Sept. 13	Oct. 11	0.01

Stock Quotations

There were no sales at auction reported in either New York, Boston or Philadelphia during the week ended Sept. 22.

COLO. SPRINGS	Sept. 21	SALT LAKE	Sept. 21
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	02¾	Beck Tunnel	.05½
Cripple Cr'k Con.	.009	Black Jack	.07
C. K. & N.	.02	Colorado Mining	.09
Doctor Jack Pot	.09¼	Crown Point	.00¾
Elkton Con.	.25	Daly-Judge	6.90
El Paso	.77	Gold Chain	.15
Findlay	.04	Grand Central	.54
Gold Dollar	‡.02	Iron Blossom	.70
Gold Sovereign	.03½	Little Bell	‡.10
Golden Cycle	1.80	Lower Mammoth	.02¾
Isabella	.15½	Mason Valley	‡1.50
Jack Pot	.06½	May Day	.16
Jennie Sample	‡.02	Opohongo	.00¾
Jerry Johnson	.04	Prince Con	.62
Lexington	.005	Seven Troughs	.01½
Mary McKinney	.36½	Silver King Coal'n	3.20
Pharmacist	.008	Silver King Con	2.00
Portland	1.50½	Sioux Con.	.01½
Raven B. H.	.02½	Uncle Sam	.05½
Vindicator	1.59	Yankee	.30

TORONTO	Sept. 21		
Bailey	.04	Dome Exten	.30
Conlagas	3.75	Foley O'Brien	.30
Peterson Lake	.18	Hollinger	25.00
Right of Way	.05	Imperial	.05
Seneca Superior	‡.78	Jupiter	.12
Silver Queen	.01	McIntyre	.47
T. & Hudson Bay	21.00	Pearl Lake	‡.00½
Timiskaming	.36	Porcu. Crown	.65
Wettlaufer-Lor	.06	Preston E. D.	.05
Dome Mines	22.75	Rea	‡.09

SAN FRANCISCO	Sept. 21		
Comstock Stocks		Misc. Nev. & Cal.	
Alta	.05	Belmont	3.62½
Andes	.08	Jim Butler	.80
Best & Belcher	.05	Lone Star	.05
Caledonia	.50	MacNamara	.02
Challenge Con	‡.05	Midway	.14
Chollar	.03	Mont.-Tonopah	.32
Confidence	.16	North Star	.10
Con. Virginia	.08	Rescue Eula	.08
Gould & Curry	.03	West End Con	.59
Hale & Norcross	.03	Atlanta	.28
Jacket-Cr. Pt	.13	Booth	.45
Julia	‡.03	C.O.D. Con	.04
Mexican	.31	Comb. Frac	.08
Occidental	.79	D'field Daisy	.03
Ophir	.18	Jumbo Extension	1.35
Overman	.07	Pitts.-Silver Peak	‡.06
Potosi	.04	Round Mountain	.41
Savage	.03	Sandstorm Kendall	.12
Sierra Nevada	.19	Silver Pick	.07
Union Con	.32	Central Eureka	.09

N. Y. EXCH.	Sept. 21	BOSTON EXCH	Sept. 21
Name of Comp.	Clg.	Name of Comp.	Clg.
Am.Sm.&Ref.,com	84⅛	Adventure	1½
Am. Sm. & Ref., pf.	107½	Ahmeek	398
Am. Sm. Sec., pf. B.	80	Alaska Gold M	32¾
Anaconda	71⅞	Algomah	2½
Batopilas Min	1⅛	Allouez	54
Bethlehem Steel	354⅛	Am. Zinc	52⅛
Bethlehem Steel, pf.	164	Ariz. Com., ctfs.	8⅛
Chino	44⅛	Bonanza	.35
Colo. Fuel & Iron	52⅛	Butte-Ballaklava	3⅛
Crucible Steel	95⅛	Butte & Superior	60
Federal M. & S., pf.	48	Calumet & Ariz.	62
Great Nor., ore., ctf.	44⅛	Calumet & Hecla	543
Guggen. Exp.	65	Centennial	18
Homestake	118	Cliff	‡.90
Inspiration Con	35	Copper Range	54⅛
Mex. Petroleum	87	Daly West	2
Miami Copper	27½	East Butte	12
Nat'l Lead, com	65⅛	Franklin	9
National Lead, pf.	110⅛	Granby	86
Nev. Consol.	14⅛	Hancock	17
Ontario Min	3	Hedley	26
Quicksilver	2½	Helvetia	.25
Ray Con	22	Indiana	5
Republic I&S, com.	45	Island Cr'k, com	46⅛
Republic I&S, pf.	100½	Island Cr'k, pfd.	89½
SlossSheff'd, com	52½	Isle Royale	27
Tennessee Copper	55½	Keweenaw	2⅛
Utah Copper	66½	Lake	13½
U. S. Steel, com	76	La Salle	4⅛
U. S. Steel, pf.	113½	Mass	10
		Mayflower	3½
N. Y. CURB	Sept. 21	Michigan	2⅛
Alaska Juneau	12	Mohawk	72½
Alta Con	.26	New Arcadian	9½
Beaver Con	.29	North Butte	29½
Big Four	.05	North Lake	1½
Blue Bell	.03	Ojibway	1½
Braden Copper	8½	Old Colony	3
Buffalo Mines	⅛	Old Dominion	51½
Can. Cop. Corpn	⅛	Osceola	84
Cashboy	.03½	Quincy	81
Chambers Ferland	.13	Santa Fe	2½
Chile Cop.	18	Shannon	6⅛
Con. Ariz. Sm.	.75	Shattuck-Ariz.	24½
Con. Coppermines	1½	Superior	26½
Con. Nev.-Utah	⅛	Superior & Bost.	2½
Dia. Black B.	.05	Tamarack	55⅛
Florence	.44	Trinity	3½
Goldfield Con.	1 5/16	Tuolumne	.37
Goldfield Merger	.18	U. S. Smelting	41½
Greene Cananea	39	U. S. Smelt'g, pf.	46
International Nickel	200½	Utah Apex	3½
Kennecott Cop.	53⅛	Utah Con	12
Kerr Lake	3⅛	Victoria	2½
La Rose	9/16	Winona	3
Magma	15½	Wolverine	58
McKinley-Dar-Sa	.22	Wyandot	1½
Mines of Am	‡2⅛		
Nevada Hills	.18	BOSTON CURB	Sept. 21
New Utah Bingham	3⅛	Bingham Mines	7¼
Nipissing Mines	7⅛	Boston Ely	.22
Oro	.07½	Butte & Lon'n Dev.	.30
St. Joseph Lead	13	Calaveras	1½
South Utah	.15	Calumet-Corbin	.04
Stand'd Oil of N.J.	451	Chief Con	.90
Standard S. L.	1⅛	Cortez	.40
Stewart	11/16	Crown Reserve	.37
Success	.89	Davis-Daly	1½
Tonopah	5⅛	Eagle & Blue Bell	1⅛
Tonopah Ex.	2½	First Nat. Cop.	2⅛
Tonopah Merger	.36	Houghton Copper	2½
Tribullion	5/16	Iron Cap Cop., pf.	5
Tularosa	‡½	Majestic	.51
Yukon Gold	2½	Mexican Metals	.19
		Nevada-Douglas	.75
LONDON	Sept. 9	New Baltic	2½
Alaska Tre'dwell	£6 16s 3d	New Cornelia	9½
Burma Corp.	1 13 1½	Ohio Copper	.10
Cam & Motor	0 12 9	Oneco	.50
Camp Bird	0 4 9	Raven Copper	.12
El Oro	0 7 0	Rex Cons	.51
Esperanza	0 7 3	Smokey Dev	.15
Mexico Mines	3 11 3	So. Lake	5½
Nechi, pfd.	0 12 0	Tonopah Victor	.29
Oroville	0 14 6	Trethewey	.11
Santa Gert'dis	0 7 6	United Verde Ext.	6
Tomboy	1 0 3		
Tough Oakes	0 6 6	‡Last Quotations.	

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	48.477	28.357	26.573	22.753
March	57.870	58.067	50.241	26.669	26.788	23.708
April	59.490	58.519	50.250	27.416	26.958	23.709
May	60.361	58.175	49.915	27.825	26.704	23.570
June	58.990	56.471	49.034	27.199	25.948	23.267
July	58.721	54.678	47.519	27.074	25.219	22.597
August	59.293	54.344	47.163	27.335	25.979	22.780
September	60.640	53.290		27.986	24.260	
October	60.793	50.654		28.083	23.199	
November	58.995	49.082		27.263	22.703	
December	57.760	49.375		26.720	22.900	
Year	59.791	54.811		27.576	25.314	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York		London			
	Electrolytic		Standard		Best Selected	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	14.394	65.259	63.494	70.188	*
March	14.131	14.787	64.276	66.152	69.170	*
April	14.211	16.811	64.747	75.096	69.313	*
May	13.996	18.506	63.182	77.600	67.786	*
June	13.603	19.477	61.336	82.574	66.274	95.333
July	13.223	18.796	60.540	76.011	64.955	91.409
August	*	16.941	‡	68.673	‡	82.333
September	*		‡		‡	
October	*		‡		‡	
November	11.739		53.227		‡	
December	12.801		56.841		*	
Year						

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.550
February	39.830	37.415	181.556	176.925
March	38.038	48.426	173.619	180.141
April	36.154	47.884	163.963	166.225
May	33.360	38.790	150.702	162.675
June	30.577	40.288	138.321	167.636
July	31.707	37.423	142.517	167.080
August	*	34.389	‡	151.440
September	32.675		‡	
October	30.284		‡	
November	33.304		159.391	
December	33.601		147.102	
Av. year	34.301			

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	3.827	3.937	3.718	19.606	19.122
March	3.970	4.053	3.850	3.997	19.651	21.883
April	3.810	4.221	3.688	4.142	18.225	21.094
May	3.900	4.274	3.808	4.182	18.503	20.347
June	3.900	5.932	3.810	5.836	19.411	25.170
July	3.891	5.659	3.738	5.531	19.051	24.611
August	3.875	4.656	3.715	4.520	‡	21.946
September	3.828		3.658		‡	
October	3.528		3.384		‡	
November	3.683		3.585		18.500	
December	3.800		3.662		19.097	
Year	3.862		3.737			

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	8.436	5.228	8.255	21.413	39.819
March	5.250	8.541	5.100	8.366	21.460	44.141
April	5.113	10.012	4.963	9.837	21.569	49.888
May	5.074	14.781	4.924	14.610	21.393	68.100
June	5.000	21.208	4.850	21.038	21.345	100.614
July	4.920	19.026	4.770	18.856	21.568	97.250
August	5.568	12.781	5.418	12.611	‡	67.786
September	5.380		5.230		‡	
October	4.909		4.750		‡	
November	5.112		4.962		25.016	
December	5.592		5.430		27.369	
Year	5.213		5.061			

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported. ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.45	$13.99	$13.90
February	15.06	14.55	14.12	13.45	14.08	13.90
March	15.07	14.55	13.91	13.45	14.10	13.95
April	14.90	14.55	13.90	13.45	14.13	13.95
May	14.90	14.61	13.90	13.60	14.27	13.83
June	14.90	14.70	13.90	13.67	13.96	13.77
July	14.90	14.94	13.90	13.91	13.90	13.68
August	14.90	16.01	13.90	15.31	14.08	14.75
September	14.90		13.90		14.03	
October	14.84		13.75		13.97	
November	14.59		13.43		13.83	
December	14.70		13.45		13.83	
Year	$14.88		$13.78		$14.01	